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AUTOMOTIVE INDUSTRIES
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VOL. XXXVIII NEW YORK—THURSDAY, JANUARY 17, 1918—CHICAGO No. 3

Aviation Chief Topic at S. A. E. Winter Meeting

Reasons Behind the Liberty Engine Discussed by Vincent, Clark and Crane—Coffin Tells of Progress in Production—Important Airplane Standards Adopted

NEW YORK CITY, Jan. 10—Aviation came into its own to-day. Recognized as of paramount importance in the current affairs of the nation it was given a great deal of attention at the annual meeting and banquet of the Society of Automotive Engineers this afternoon and evening.

For the first time details of the Liberty engine were disclosed. The progress of the entire aeronautical program of the United States was reviewed and the entire membership of the engineering organization which has done so much to further the aerial preparedness of this country was made acquainted with all the facts which could, in the interest of the public, be made known.

Major J. G. Vincent unveiled the Liberty engine first by giving the story of its development, in conjunction with talks by Col. V. E. Clark and H. M. Crane on the same subject. Major Vincent then for half an hour answered questions covering practically every detail. These questions were asked by members of the S. A. E. gathered at the professional session in the auditorium of the Engineering Societies Building.

Finally, at the banquet held at the Biltmore, attended by over 1000 members and guests, Howard E. Coffin, Chairman of the U. S. Aircraft Board, gave the whole story of the progress of the air program from a political and economic viewpoint. He told of the development of the idea and how it finally, on July 24 last, was accepted in concrete form and led to an appropriation of $640,000,000 being made.

From the opening of the professional session to the end of the dinner, aircraft work occupied the attention of the visiting engineers. In the morning a comprehensive program of airplane standardization was undertaken and put through. Nearly thirty new standard or recommended practices were passed upon and will be put immediately into effect. These recommended practices cover all phases of airplane construction and will be of vital importance in reducing the number of different types of materials and parts; they are, therefore, of the highest importance in carrying out the aircraft program on an economical basis.

During the afternoon session the symposium on the Liberty engine was given, terminating in a questionnaire in which Major Vincent answered in detail all the questions which members asked of him, and incidentally set at rest the minds of the engineers on the true value of the Liberty engine. The fact that this engine was designed with 8 months' improvements in view makes it stand to-day as good as, if not better than, anything that Europe has to offer. In fact, it was brought out at this session that European powers have ordered these engines in large numbers for their own planes.

Finally, the banquet in the evening was largely given up to aviation speeches, terminating with the address by Howard Coffin, in which the progress of the United States on aviation work was shown to be fully up to schedule in every respect. This includes not only the planes themselves, but the pilots and

mechanics to operate and maintain them.

Undoubtedly the most important feature of the meeting was the light it threw on the Liberty engine. For months the people of the country had been engaging in conjectures regarding the power plant which is to play such an important part in this country's war on the Central Powers.

The speculation was not confined to engineers, but was engaged in by the public at large as well, and as a result many unfounded rumors spread all over the country. The fact that the engineers responsible for the engine stood ready to-day to answer any questions of the engineers regarding it shows that America has every reason to be proud of the Liberty engine.

Having a weight efficiency of 2 lb. per horsepower, it is capable of developing, as a twelve-cylinder unit, 400 hp. It is in this form alone that it will be built at the present time, because with the present stage of plane development less horsepower than this would not be up to all the requirements of the best work and more than this cannot be economically handled. The standardized 5 by 7 cylinders, although of steel, can be manufactured by special processes on a quantity-production basis and have proved to be a great success. From the original design very few changes had to be made. Certain parts were slightly strengthened, thereby adding 15 lb. to the total weight of the unit which originally weighed 786 lb., or even less than 2 lb. per horsepower.

The advice of the British and French aviation commissions has been invaluable in bringing this engine up to a standard that is higher than anything yet brought out, and Major Vincent dwelt at length on the great advantages in having designed the engine the way it was, under a centralized organization in the hands of two men in Washington. In this way the co-operation of the entire automobile industry was secured; had the engines of foreign countries been placed in the hands of several factories for the purpose of getting out an aviation engine, there would perhaps have been eight or ten engines designed which would have been very good. Difficulties would have cropped up, however, because they would not have been standardized. Furthermore, Major Vincent stated that he is convinced that none of these engines would have been any better than the Liberty engine because none of the designers would possibly have had all the information that was available to the designers of the Liberty engine.

Major J. G. Vincent

Co-designer with Major E. J. Hall of the Liberty Aircraft Engine. Major Vincent was formerly chief engineer of the Packard Motor Car Co.

The best that Europe could provide was taken and made fit for American methods and American workmen. It has been learned by experience that it is not possible to successfully produce on American machines, with American shop methods and American labor, a strictly European design without a long period of adjustment. This phase of the matter was very clearly brought out by H. M. Crane, who has had invaluable experience in manufacturing at his New Brunswick plant the Hispano-Suiza type. This type was chosen because it was designed by one of the best production men in Europe, yet even with this indorsement behind it, it required a long time to adapt it to American methods.

From a purely tactical and military viewpoint, Col. V. E. Clark showed that we have not really realized the vast amount of damage that can be inflicted by bombing machines. In fact the war can be won, according to the colonel, if this method is pursued far enough and the complete mastery of the air is secured and maintained. Night bombing operations are carried out with little military risk, because it is practically impossible for the anti-aircraft artillery to do effective work, and if the plane is picked up by a searchlight it is easy to escape by sending out a flare or by some other means. Machines in the air cannot fight very well at night,

because of the impossibility of telling whether a machine belongs to the enemy or is a friend.

These night bombing operations, using gas and destructive bombs, over industrial centers, when carried on by large groups of planes with large carrying capacity, can paralyze these centers, and, in addition, roads and railroads immediately in the rear of the army can be so torn up that the front is put in a precarious condition. In fact, a siege under disadvantageous conditions exists.

Symposium at Professional Session

The symposium on the Liberty engine, taken part in by Col. V. E. Clark, Major J. G. Vincent and H. M. Crane of the Wright-Martin Co., was the most important part of the entire meeting. Col. V. E. Clark spoke of the requirements of the different types of planes and showed the important work that these planes can do toward winning the war. He told of the almost immeasurable effects upon the morale and physical resources of the enemy by night bombing operations, the use of large fleets of night bombing machines which he said would be of fundamental importance in winning the war. Col. Clark also went into the uses of the single seated and double-seated combat and observation machines, the heavy types of bombing machines, and also told of the requirements of pilots in operating the different types.

Major J. G. Vincent spoke of the step-by-step processes by which the Liberty aircraft engine was designed. He told why it was that the entire program was put in the hands of a few men instead of being distributed among a number of factories, explaining that if the latter had been done it would have been impossible to get down to a production basis, in spite of the fact that several good engines would no doubt have been designed. Major Vincent said that he is quite certain that no better engine could be produced, as this was designed to be from six to eight months in advance of the best European type now in use. Furthermore, it is a production engine which can be turned over to numerous factories throughout the country for manufacture.

H. M. Crane told of the manufacturing fundamentals behind the Liberty engine. Epitomizing his talk, he told how the engine was adapted to the industry instead of the industry being adapted to the engine; he also showed how the foreign engines, taken as they are, do not readily permit of American methods.

Military Types of Airplanes Discussed by Col. V. E. Clark

IN this war the Allies have a greater number of types than the enemy. One reason for this is that the Allies have listened more to the demands of the pilots using the machines. The Americans are trying to select those types that render themselves readily to standardized production.

The various military types can be divided into airplanes of observation, airplanes of combat and airplanes of destruction. None are new—each type has its different functions.

Airplanes of observation act in connection with field artillery, act with the infantry and keep in touch with lines of communication and keep commanders in touch with movements; take photographs; make maps beyond the lines and dive down and inflict damage on trenches by machine guns. It is hard to draw a line between the types. The airplanes of observation may carry two or three men.

The latest development in France is the army observation machine for three men and the engine is 500-hp. Airplanes of combat and pursuit are usually single or two-seater. Each, of course, has its advantages. The development of more powerful engines will militate against the single-seater, and eventually it may entirely be replaced by the two-seater.

The airplanes which do the real damage are the third type—those of destruction. Of course a very brilliant fellow can go up and bring down ten of the enemy, but bombing airplanes will inflict the real damage. The bombers are divided into day and night machines. They are entirely different.

The day bomber carries two men. For the present we have to stick to one propeller on the day machine. They bomb headquarters, ammunition plants, factories, trenches and warehouses. They do photographing also. They must be able to protect themselves from all possible aircraft.

It is not economical to send trained pilots a great distance beyond the lines unless the machine carries 600 to 800 lb. of bombing material. It should carry two or three machine guns. Day bombing will be done in the future in formation with as many machines as can be flown without any particular risk of collision. These will be in multiples of five. The German Gotha has two 260-hp. Mercedes engines. These types have bombed London during the day.

The night bombing will inflict real damage. The night bomber is different from the day. It is not necessary to be fast. Night fighting is almost unheard of. The primary requirements are good bombing capacity. Two Liberty engines carrying three or four men should be able to carry roughly at least 1 ton of bombs. Two pilots are carried, the chief pilot and the bomber. Machines that have a ceiling of 10,000 ft. running 85 m.p.h. are ample. Greater speed means more power or less carrying capacity. In the case of a machine with two Liberty engines for every 16 miles' range, 100 lb. of bombs must be sacrificed.

The number of night bombing airplanes built and supplied should depend solely upon the number of pilots available. It depends upon the work they have to perform. They cannot be put closer than 1000 yd. without tangling the wireless communications. The number built depends upon the strength of the army. There is no limit on bombing machines. The number will also probably depend on steam-

Col. V. E. Clark
Officer in Charge of Aircraft Engineering for the Signal Corps

ship space for transportation and possibly upon the appropriation.

Each airplane carries 1½ tons of bombs. If we could send out 500 machines every third night, each dropping 500 bombs on the factory towns, there would not be much war after that. That would wreck all railroads, and telephone and telegraph lines would then be destroyed.

J. G. Vincent Traces Steps in Liberty Engine Development

GO back to April or May when the Government had the job to decide about the airplane program. Considerable time was put in going over the situation, and what was then called the Aircraft Production Board was in charge of the job.

The French and English agreed that there was nothing here that would be of value at the front. We did not have

H. M. Crane

Chief engineer of the Wright-Martin Aircraft Corp., who has had extensive experience in building foreign airplane engines in this country

the engine they wanted at that time. It was finally decided we should get together all the best things embodied in those of the Allies and combine them. We wanted to combine all the benefits of the experimental work of the Allies, and at the same time produce manufacturing results that had been produced by the Germans, that is, cut down to the fewest possible parts. The scheme as originally laid out consisted in making a number of engines of interchanging parts, cylinders from four to twelve and possibly more, if that seemed desirable, later.

However, it was decided to first build an eight-cylinder of approximately 250 hp., but before that was complete we were asked to use the twelve-cylinder of over 300 hp. because the cry for more power was being heard. Of course, we had the men on the other side sending information. We took all this information and combined it with our own experience to produce a standardized aircraft engine.

We decided it was absolutely necessary to design this engine and have the Government follow it through so that manufacturers could produce in quantities. The automobile engineers co-operated on this job. It was only on the 4th of June that Major Hall and I were given the order to produce ten sample engines. We went back to Detroit and got out rough detail drawings. The first engine was produced in 21 days because we got everybody's co-operation. That shows what can be done through co-operation, and we can only do things with co-operation. We do know how to produce in large quantities and produce them good if we have a definite program. The first built in 21 days was an eight-cylinder. You can realize the importance of having a standardized engine.

If you have two planes identical save for the engine, it is almost impossible to take out one and put in another without redesigning the plane. We took the cylinders and valve operating mechanism and the crankcase and crankshaft construction, connecting rod, the generator, intake head. So long as it was good it made no difference.

When we finished the twelve-cylinder engine we put it to a test and made not a single adjustment through a 50-hr. run. We did not put that through the 50-hr. at maximum hp. on the ground, because the engine was designed not to be run open on ground. It developed 2 lb. to the horsepower. Since that time we have found out that it will run for an indefinite period wide open on the ground. It develops 400 hp.

Manufacturing Facilities Organized

The Aircraft Production Board was not asleep. In the meantime very large facilities were being provided for manufacturing. The equipment for manufacturing steel cylinders is a very large proposition. Everything was taken up and carefully studied. Each factory will produce the same thing and have interchangeable parts as far as possible. There is another thing that is going to be a great benefit. We have been co-operating with the automobile engineers for years. If we had brought in different aircraft engines from abroad and distributed them around the plants it would have resulted in great jealousy, each keeping his own knowledge to himself. The most important of all is with the standardized engine you get the benefit of everybody's co-operation. We have nothing but twelves in production because it is the one with the most power. With it we get over 400 hp. and that is all we know how to use efficiently to-day.

Liberty Engine Production Problems Touched On by H. M. Crane

IN laying out a production schedule the whole industry had to be taken as it was and not in some different way. There must be many here who have done development work, and as you know, the most successful engine is the one designed to meet the factory idea and temperament. If you do not do that production is delayed.

Production with a foreign motor would never have been half what we can expect from a motor designed in this country with the knowledge of all the American factory practice. When I heard in the newspapers in the early part of the summer that a motor had been designed in 2 weeks I was very much surprised. When I had the privilege of coming closer to what had been done I found that this was only the final printing. What had occurred was a year or 2 years of development, always thinking in terms of American methods.

Difficulties of Producing Foreign Engines Here

I have been working on a foreign motor. It was designed by the best production engineer on the other side. It is for that reason it has been so successful on the other side, and yet it contained difficulties that had to be met.

Speaking of the distance we are from the other side—we are distant in our way of thinking and we are distant in miles.

Therefore, it is difficult to copy foreign practice. As an illustration of the difficulty of this, all we need to do is to look at the Mercedes. That has been copied by many, yet no

one who has copied it has reached its efficiency or usefulness. The makers who have started to copy it and who reached a fine product have altered their processes and design very materially. That would happen to us if we had started on a foreign design. The best foreign designs are not inventions. An aviation motor must be of the simplest form and the Liberty is the embodiment of the simple idea of compactness, which makes for light weight and reliability.

Following the talks on the Liberty engine, Major J. G. Vincent expressed himself as ready to answer all questions regarding the Liberty engine, and for nearly an hour a running fire of questions covering the engine was answered by the major in clear-cut, convincing style. It was impossible to leave the meeting without feeling that America has the best aviation engine that has as yet been produced. The more important responses to inquiries are digested herewith.

Digest of Major Vincent's Replies to Questions on the Liberty Engine

THE cruising radius of the plane is a matter of load, speed and plane design. It is easily up to 600 miles.

The 12 will be the only Liberty engine in production. There is no idea of building anything else at the present time. There is no doubt, however, that improvements will be incorporated from time to time, and a gear type may be added to the direct connected engine now manufactured.

Regarding ignition, the increased speed and number of cylinders make it very questionable if the magneto is the best form. Two separate sparks per cylinder must be furnished, and they must be independent in every respect so that should one go out of order the other will fire regularly. While the magneto is now questioned, there is every disposition on the part of the engineers to listen to suggestions on both types, and the ignition, as now provided, is at least as good as could be designed. The committee is going right ahead with what they have in ignition at the present time. An interesting point is that nobody has as yet offered a system which is as light as the one now in use.

Weight Data

Regarding weight per horsepower, the engine originally weighed 786 lb. and delivers 400 hp. at 1625 r.p.m Due to the strengthening of certain parts, the weight has been increased and is now 801 lb., giving 2 lb. to the horsepower—the weight per horsepower on the best French machines, such as the Hispano geared type, as the engine weighs 520 lb. and produces 220-hp. There are two compressions on the present Liberty engine, a compression ratio of 5 to 1, or 20 per cent, being used on the navy machines, and a ratio of 5.4 to 1, or 18 per cent, on the army machines. This is because the army machines do their flying at above 10,000 feet elevation and get up to this height just as soon as possible. This compression is based on the best practice abroad, although experiments are being made on higher compressions, and it is known that a 6 to 1 ratio can be provided without trouble.

For lubrication we are trying to get castor oil, but a good grade of mineral oil is quite satisfactory. The supply of castor oil has lately been increased, but there is no difficulty on the score of lubrication.

In answer to a question at this point, Col. Clark stated that the average life of a combat machine is two months, or about 100 hours of flying and fighting. Observation machines have a slightly longer life, the average being about three months. The bombing machines have an indefinite life, generally ending their careers through wear rather than through actual damage.

High Altitude Performance Important

Major Vincent, in resuming, said: "If 48 engineers had been put on the Liberty engine job, it would never have been built." There is a great amount of research work still to be done, particularly as regards performance at altitudes of over 20,000 feet, and it is this high altitude work which is most important. The lessons learned by studies at the top of Pikes Peak have not all been applied as yet, owing to lack of time. The 400-hp. engine means only 200-hp. to the aeronautic man, as he is used to operating where pressures are down to 45 per cent of atmospheric.

Regarding spark plug trouble, it has been possible with the special design of cylinders to bring the water close to the plugs. The Liberty engine is not a hard engine, relatively speaking, as regards spark plugs, particularly as no real extreme compressions are used. Carburetion is not exactly right even now for the high altitudes. No starter is necessary on the machines now under construction, as it is impossible to stop the Liberty engine, once the machine is in the air, as it cannot be driven slowly enough to stop the engine from turning over.

Regarding the possibility of the engine with four valves per cylinder, Major Vincent stated that there is no necessity for this, as four valves are harder to cool and are apt to cool unequally. Until the lift equals one-quarter of the diameter of the valve, the full value of the valve is not obtained. There is a possibility of there being, at some future time, an engine with two inlet valves. There is no radical feature in the valve timing as the exhaust opens 52 degrees before bottom center and the intake closes 45 degrees as to bottom center.

Mechanical Details

The ignition apparatus weighs 29 lbs., including the battery. The fuel feed is by pressure system, with a pump on the engine and a blow-off valve in the tank. The valve mechanism is operated by a rocker through a bearing, and any oil getting out must escape through this bearing, thus lubricating it. The piston clearance was at first set at .016 in., but after increasing the diameter of the valve 1-16 in., resulting in a gain of 12 lbs. m.p.p. pressure, the clearance was raised to .020. The piston is straight up to the bottom of the top ring. The engine is a dry crankcase type and the cylinder dimensions are 5 x 7. The period of the engine is at 1200 r.p.m., and in making tests propellers are used while the power curves are taken on an electric dynamometer. Domestic materials only are employed in the manufacture. The valves are 2½ in. in the clear with a life of ⅜ in. for the exhaust and 7-16 for the intake.

Automotive Industries Dinner

THE annual dinner of the S. A. E. took place at the Biltmore Hotel on Thursday evening, Jan. 10. The great ballroom of the hotel was filled to the last seat, as was the balcony, and a number of tables were placed in adjoining rooms. Retiring president, Geo. W. Dunham, presided, and John Kendrick Bangs acted as toastmaster. At the speakers' table were seated, besides the president and toastmaster, Capt. M. E. De Jarny, Brig.-Gen. J. D. Cormack, Howard E. Coffin, C. F. Kettering, Gen. P. Tozzi, Col. Tozzi, Major Edward Orton, Jr., Capt. J. S. Critchley, C. W. Stiger and J. B. Bartholomew.

After a short opening address by President Dunham and a witty talk by Toastmaster Bangs, J. G. Vincent spoke on the work of aircraft engine production. He was followed by Charles F. Kettering, who had for his subject the importance of the internal combustion engine in our present civilization and co-operation in the engineering industries as fostered by the S. A. E. Capt. De Jarny of the French army outlined the industrial history of the war and of the help rendered the Allies by American industries. The last speaker of the evening was Howard Coffin, who spoke on the aircraft production work. Mr. Coffin stated that the enlargement of the scope of the S. A. E. was first planned on the last summer outing on the Great Lakes. Mr. Coffin referred to the criticism that had been passed on the Aircraft Production Board, and he answered this criticism. Many had suggested that the best aircraft engine possessed by the Allies should have been selected as a standard model, but the trouble with this suggestion was that European engineers were far from being agreed as to the best aircraft engine. In fact, they were not fully satisfied with any engine they had. Moreover, the engines of European design were not adapted to American production methods. The first model of Liberty engine built was an eight-cylinder model.

Howard Coffin Shows Progress in Aircraft Program

Building of Machines and Training of Aviators and Mechanics Fully Up to Schedule

HOWARD E. COFFIN, chairman of the United States Aircraft Board, addressed the dinner at which were assembled more than a thousand members and guests of the S. A. E. Mr. Coffin's address came as a grand finale in the aircraft sessions of the day and was a fitting complement to the address of Major Vincent during the afternoon. While Major Vincent showed that we have the aviation engine problem well in hand, Howard Coffin gave the information that our entire program, not only of building planes but of training men and sending men and the necessary machines to France, is up to schedule.

Mr. Coffin told how the seed of the present-day aviation plan was planted on the trip of what was then the Society of Automobile Engineers, on the steamship Noronic during the summer of 1916. At that time the idea that America must have its military future largely in the air was first propounded. Previous to 1917 the appropriations for aircraft for several years averaged around $125,000, and our equipment did not total more than one squadron. Our aircraft program for the year 1918 is reaching close to the billion-dollar mark. This is a total which represents the same magnitude as the automobile industry for a year.

The aircraft plans agreed on after full conference with the Allied powers provide for the purchase of airplanes on the other side to take care of American needs until July 1 of the present year.

Howard E. Coffin

Chairman of the Aircraft Board, who reviewed at the S. A. E. dinner the progress made in the country's aircraft program

One of the first things done by the Government after the President, on July 24 last, approved the Aircraft Act with its $640,000,000 appropriation, was to authorize General Pershing to place orders for several thousand fighting machines in allied countries. Many millions of dollars' worth of materials and machine tools have been shipped from the United States to aid foreign production.

Aircraft materials have been standardized with the Allies' in detail and type. A complete co-ordination of manufacturing facilities and policies has been agreed upon between the Allied Powers.

Thousands of American mechanics are being put into actual service with the Allied forces. Trained men will be released as needed in the United States service and their places kept filled with fresh material. The personnel for such increase is already available.

In accordance with the plans originally agreed upon with the Allied Governments, it was deemed advisable to provide for advanced training overseas adjacent to the actual theater of military operations, but so energetic has been the work of the personnel division of the Signal Corps that the training facilities were soon overcrowded, with the resultant request that early arrangements for advanced training be made in America.

To meet this change in program delivery of advanced training planes will begin this month, and within ninety days will have met requirements. The engines of foreign design for this advanced training schedule are already in quantity production in this country.

We have seen and heard much of the proposal of "100,000 airplanes" to be provided by the United States within the next year. In a country where one great industry produces 1,500,000 motor cars per year the fabrication of 100,000 planes might seem easy, but actual figures based upon three years of practical experience in the war show that there are now between forty and fifty men of the auxiliary service required for each active machine at the front. If this same ratio should be adhered to in our service it would mean that 4,000,000 men would be required in our aeronautical department on foreign soil between our ports of debarkation and the fighting front.

Even though this number could be reduced by 50 per cent by increased efficiency and standardization, the number required is still staggering. Consider also the overseas transportation problem as related to material only and without reference to personnel and its maintenance. Again, the problem of proper housing behind the battle lines in Europe of such great numbers of planes as are carelessly discussed may well be left to sober thought.

Every decision of the Aircraft Board has been based upon the military policies of the front. Daily cable communication with Allied countries is maintained.

New sources of supply, flying fields, the experimental laboratory and other activities, under the direction of the board, have been purposely located west of the Allegheny Mountains in accordance with the stated policy of the military departments to remove sources of war supply "200 miles from the sea coast," and to avoid the labor congestion which exists in all Eastern industrial centers.

Established plants of the motor car industry are being largely utilized in aircraft motor production, but not in airplane construction. In general, the statement may be made that not a single automobile factory is in any way involved in the plane building industry, but many are making engines.

Many New Aircraft Practices Have S. A. E. Sanction

Final Action Taken by the Standards Committee and the Council on Twenty-Three Items Relating to Aircraft Practice—These Recommended Practices Will Be Used by Government Departments Either Directly or as a Basis in Drawing Up Specifications

EDITOR'S NOTE—*More than half the time of the Standards Committee at its all-day session on Jan. 9 was taken up in reviewing and acting on recommended aircraft practices. Practically all of the subjects had had very thorough consideration in committee and the work went through the Standards Committee very smoothly. Only one subject, that of glues, was referred back to the division for further consideration. Although these recommended practices are still subject to a mail vote by the whole membership, they may be regarded as finally adopted. We reprint a number of the new "practices" herewith and will print the remainder in succeeding issues.*

Cellulose Acetate Dope

S. A. E. Recommended Practice

The temperature of the doping rooms of airplane factories should be maintained at 70 deg. F. The airplane manufacturers should store the dope under a roof.

Definition—(1) Dopes for airplane fabrics must consist of a clear, uniform mixture of ingredients and be capable of shrinking the fabric to the degree of tautness desired by the customer's inspection. The residual film should be reasonably transparent, and free from white spots and should give a smooth, homogeneous surface when applied in a horizontal position in an atmosphere not exceeding 65 per cent humidity and 75 deg. F. temperature, free from direct draft.

Viscosity—(2) the viscosity of the dope must permit of direct application without dilution at a temperature not lower than 60 deg. F.

Coating—(3) The dope, when dry, must adhere to the fabric with sufficient tenacity to prevent peeling off in sheets. Test strips should show lint attached to the side which has been in contact with the fabric.

Effect on Tensile Strength and Weight—(4) Four coats, or an equivalent of the dope, 48 hours after application, must increase the tensile strength of linen fabrics not less than 25 per cent of the original average strength of warp and filling and of cotton fabric not less than 15 per cent. The increase in weight per square yard of doped fabric should not be less than 2 ounces or greater than 2.75 ounces. The test should be made under standard conditions of humidity and temperature on standard fabrics.

Acidity—(5) No mineral acids may be present in the dope and the amount of free organic acidity figured as acetic acid may not exceed 0.2 per cent. No compounds may be present which would be injurious to the fabric.

Sulphates—(6) Dopes which show the presence of free sulphuric acid by the test given below are not acceptable.

Tetrachlorethane—(7) Dopes containing tetrachlorethane will not be acceptable for repair work, but will be admissible in factories provided with adequate ventilation.

Cellulose Acetate—(8) The cellulose acetates used should contain no free mineral acid and not more than 0.1 per cent free acetic acid, and should be stable. The amount of cellulose acetate shall not be less than 60 grams per liter of dope.

Solvents—(9) The volatile solvents employed should present no danger to the workman applying them.

Inflammability—(10) Five drops of gasoline dropped on the film which has been dried for 48 hours and immediately ignited should have no more serious effect than to char the fabric under the moistened section of the film.

Exposure Test—(11) Dopes must comply with the following test: A square frame, 12 in. by 12, inside measurement, is covered on both sides with fabric, the fabric being tacked to the outer side of the frame. The fabric is to be tacked under uniform tension, simulating that employed in airplane manufacture. Four coats, or an equivalent, of dope are to be applied to each side of the frame, each coat being allowed thoroughly to dry before the succeeding coat is applied. The frames are to be exposed on a roof in an unshaded horizontal position, one side being constantly uppermost. After 60 days of constant exposure no spontaneous cracking of the doped surface should be apparent, and after remaining one hour at a temperature of 70 deg. to 80 deg. F., the film shall not crack and shall have a decided ring. This test should be made in duplicate and comparatively with a dope that has previously passed the test, and shall be in effect until a mechanical test is adopted.

Shipment—(12) Dope shall be shipped in metal cans, metal or wooden barrels or earthenware containers. Inspection of the containers shall be permitted to insure against the accidental introduction of foreign material. The container shall be marked with the date of manufacture, serial number, gross, tare and net weight.

TESTING OF DOPES

Acidity—(1) A 500-cc. beaker, containing about 200 cc. of water is counterbalanced on a large balance. The balance is adjusted to one hundredth gram by adding or removing water. About 10 grams of dope are poured into the water and the increase in weight noted. This is rapidly done to 0.01 gram to diminish solvent loss. The dope is stirred up and allowed to stand 10 to 15 minutes with occasional

stirring. The liquid is decanted through a rather porous filter into an 800-cc. beaker and 150 cc. of warm water added to the residue. It is allowed to stand 10 to 15 minutes with frequent stirring and poured through the filter into the 800-cc. beaker. The residue is washed with 150 cc. of warm water as before. A few drops of phenolphthalein are added and the solution titrated with twenty-fifth normal caustic soda to a color that persists for one-half minute. Some dopes, notably those containing much acetone, when poured into water precipitate as a milky solution containing shreds of the acetate. The resulting liquor filters slowly and passes through the filter paper in a cloudy condition. Since the acetate is finely divided it is practically free from acetic acid and additional washing is unnecessary. The end-point is not quite as sharp as when all the acetate has been removed, owing to hydrolysis of the suspended material, but is sufficiently accurate for all practical purposes. Absence of mineral acids must be proved by qualitative tests.

Sulphates—(2) Twenty grams of cellulose acetate dope are treated with 150 cc. of water in a pressure bottle at 100 deg. C. for 24 hours. The resulting liquor is filtered and tested for free sulphuric acid.

Amount of Cellulose Acetate—(3) Pour 25 grams of the dope into a Petri dish 6 in. in diameter and evaporate to dryness on the steam bath. Extract the residue with ether in a Soxhlet until all extractive material has been removed. Dry at 60 deg. C. to constant weight, and weigh.

Film—(4) Pour some of the dope on a glass plate and allow to dry spontaneously. The film may be examined for the general characteristics of transparency, coherence, strength and flexibility.

Cellulose Nitrate Dope

S. A. E. Recommended Aeronautic Practice

Definition—(1) Dopes for airplane fabrics must consist of a clear, uniform mixture of ingredients and be capable of shrinking the fabric to the degree of tautness desired by the customer's inspection. The residual film should be reasonably transparent and free from white spots, and should give a smooth, homogeneous surface, when applied in a horizontal position in an atmosphere not exceeding 65 per cent of humidity and 75 deg. F. temperature, free from direct draft.

Viscosity—(2) The viscosity of the dope must permit of direct application without dilution at a temperature not lower than 60 deg. F.

Coating—(3) The dope, when dry, must adhere to the fabric with sufficient tenacity to prevent peeling off in sheets. Test strips should show lint attached to the side which has been in contact with the fabric.

Effect on Tensile Strength and Weight—(4) Four coats or an equivalent of the dope, 48 hours after application, must increase the tensile strength of linen fabrics not less than 25 per cent of the original average strength of warp and filling and of cotton fabrics not less than 15 per cent. The increase in weight per square yard of doped fabric should not be less than 2 ounces nor greater than 2.75 ounces. The test shall be made under standard conditions of humidity and temperature on standard fabrics.

Acidity—(5) No mineral acids shall be present in the dope and the amount of free organic acidity figured as ascetic acid may not exceed 0.05 per cent. No compounds may be present which would be injurious to the fabric.

Cellulose Nitrate—(6) The cellulose nitrate used in the manufacture of dope shall be purified and give a negative potassium iodide test at the end of 20 minutes, according to the standard Government method for the Abel stability test. The amount of cellulose nitrate used shall be not less than 55 grams per liter of dope.

Solvents—(7) The volatile solvents employed shall present no danger to the workman applying them.

Exposure Test—(8) Dopes must comply with the following test: A square frame, 12 in. by 12 in., inside measurement, is covered on both sides with fabric, the fabric being tacked to the outer side of the frame. The fabric is to be tacked under uniform tension, simulating that employed in airplane manufacture. Four coats, or an equivalent, of dope are to be applied to each side of the frame, each coat being allowed thoroughly to dry before the succeeding coat is applied. The frames are to be exposed on a roof in an unshaded horizontal position, one side being constantly uppermost. After 60 days of constant exposure no spontaneous cracking of the doped surface should be apparent, and after remaining one hour at a temperature of 70 deg. to 80 deg. F., the film shall not crack and shall have a decided ring. This test shall be made in duplicate and comparatively with a dope that has previously passed the test, and shall be in effect until a mechanical test is adopted.

Shipment—(9) Dope shall be shipped in metal cans, metal or wooden barrels or earthenware containers. Inspection of the containers shall be permitted to insure against the accidental introduction of foreign materials. The container shall be marked with the date of manufacture, serial number, gross tare and net weight.

TESTING OF DOPES

Acidity—(1) A 500-cc. beaker, containing about 200 cc. of water, is counterbalanced on a large balance. The balance is adjusted to one hundredth gram by adding or removing water. About 10 grams of dope are poured into the water and the increase in weight noted. This is rapidly done to 0.01 gram to diminish solvent loss. The dope is stirred up and allowed to stand 10 to 15 minutes with occasional stirring. The liquid is decanted through a rather porous filter into an 800-cc. beaker, and 150 cc. of warm water added to the residue. It is allowed to stand 10 to 15 minutes with frequent stirring and poured through the filter into the 800-cc. beaker. The residue is washed with 150 cc. of warm water as before. A few drops of phenolphthalein are added and the solution titrated with twenty-fifth-normal caustic soda to a color that persists for one-half minute. Any satisfactory substitute method will be permissible on approval.

Amount of Cellulose Nitrate—(2) Pour 25 grams of the dope into 100 grams of chloroform, stirring constantly. Extract in a Soxhlet with chloroform until all extractive material has been removed. Dry at 60 deg. C. to constant weight, and weigh.

Film—(3) Pour some of the dope on a glass plate and allow to dry spontaneously. The film may be examined for the general characteristics of transparency, coherence, strength and flexibility.

Spar Varnish Specification

S. A. E. Recommended Practice

Composition and General Properties—The material shall be the best long oil varnish, suitable for application on wood, "doped" linen or cotton, and metal, and resistant to air, light and water. The manufacturer is given the greatest latitude in the selection of raw materials and process of manufacture in order to produce a product of the highest quality.

Physical Characteristics—The material shall comply with the following requirements:

(1) It shall be clear and transparent.

(2) Its color shall be no darker than a standard color solution, made by dissolving 6 grams of pure powdered potassium bichromate in 100 cc. of pure concentrated sulphuric acid (specific gravity 1.84). Gentle heat may be used, if necessary, to secure a perfect solution of the bichromate. The color comparison will be made by placing the varnish and the standard color solution in clear, thin walled glass tubes of the same diameter, 1.5 to 2 cm. (⅝ to 13/16 in.) to a depth of at least 2.5 cm. (1 in.) and comparing the colors by looking through the tubes, across the column of the liquid by transmitted light.

(3) It shall not flash below 35 deg. C. (95 deg. F.) in an open tester.

(4) The varnish will be flowed on one side of a 10 x 15 cm. (approx. 4 x 6 in.) panel of bright tin. The panels shall be approximately 0.3 to 0.4 mm. (0.0125 to 0.0158 in.)

thick, (90 to 100 lb. weight of base metal per standard box of 112 sheets, 14 x 20 in., No. 30 to No. 28 U. S. Standard plate gage), and shall be cleaned thoroughly with benzol. When the panel is held in a vertical position and maintained at a temperature of 21 deg. C. to 32 deg. C. (70 deg. to 90 deg. F.), the varnish shall set to touch at a point not less than 2.5 cm. (1 in.) from the side or top edges of the film, in not more than 5 hours; and shall dry hard in not more than 24 hours to a clear, hard, glossy film. The panel will then be allowed to dry for a further period of not less than 5 days and then brought to a temperature of not less than 21 deg. C. (70 deg. F.), nor more than 24 deg. C. (75 deg. F.) and maintained at this temperature for not less than 15 minutes. The panel with the varnished side on the outside will then be bent double rapidly over a rod 3 mm. (⅛ in.) in diameter. The varnish film shall show no cracking or flaking at the point of bending.

(5) The varnish will be applied to a basswood panel which has been filled with one coat of drop black in oil thinned with turpentine and drier, and allowed to dry for not less than 10 days before applying the varnish. It shall have suitable body to give proper brushing, flowing and covering properties. The first coat of varnish will be allowed to dry 48 hours, then lightly sandpapered, a second coat applied and allowed to dry 72 hours. The panel will then be inclined at an angle of about 45 deg. and a gentle stream of cold tap water allowed to flow down the middle of the panel for 18 hours. After wiping off with a chamois skin any deposits due to the tap water the varnish shall show no whitening, dulling or other defects. A small stream of boiling distilled water will then be allowed to flow down another portion of the panel for 20 minutes. The water will be siphoned through a small glass tube directly from a container in which it is boiling, onto the surface of the panel, in such a manner that there will be no appreciable lowering of the temperature of the water before it touches the varnish film. The siphon delivery tube will be in a plane nearly parallel to the plane of the panel, so that the impact of the water will not tend to break the film. The varnish shall show no appreciable whitening and no more than a very slight dulling, or other indications of marked deterioration, either when observed immediately after removing from the water, or after drying for two hours.

(6) The varnish will be applied in three coats to two unfilled panels of maple wood, not less than 14 x 45 x 2 cm. (5½ x 18 x ¾ in.), allowing three days for the drying of each coat. The first coat, after drying indoors for 3 days will be sandpapered lightly with No. 00 sandpaper before the application of the next coat. The second and third coats will not be sandpapered or rubbed, and the duplicate panels will be exposed outdoors, 45 deg. to the vertical, facing south, three days after the application of the finishing coat. The backs and edges of the panels will also be varnished with three coats of the same sample, but for these surfaces the details of the method of application as given need not be adhered to, and the effects of exposure on these surfaces will not be considered. On this test, the varnish shall show satisfactory durability and weather resistant properties. In cases where the award of a contract cannot be delayed for the results of the exposure test, award may be made on the basis of the other requirements; but a varnish of any specific brand which does not show up satisfactorily on exposure test may be omitted from consideration in future awards, and a preliminary submittal of samples for making exposure tests may be called for.

Round High Strength Steel Wire

S. A. E. Recommended Aeronautic Practice

This specification covers solid high strength steel wire, round section, used in the construction of aircraft when flexibility is of minor importance.

Workmanship and Finish—The wire shall be cylindrical and smooth and may show no evidence of scrapes, splints, cold shuts, rough tinning, or other defects not in accordance with best commercial practice.

Physical Properties and Tests—Tensile Test—Samples for the tensile test shall be not less than 15 in. long and free from bends and kinks. In making tensile tests on aircraft wire, the distance between jaws of testing machine, with the sample in place and before test, shall be 10 in. The wire must not break at less than the amount specified in the attached table, which is a part of this specification.

Torsion Test—Samples for the torsion test shall be straight and not less than 10 in. long. The sample shall be gripped by two vises 8 in. apart; one vise shall be turned uniformly at a speed not exceeding 60 revolutions per minute (on the larger sizes of wire this speed shall be reduced sufficiently to avoid undue heating of the wire). One vise shall have free axial movement in either direction. All wire shall be required to withstand a minimum number of turns to be agreed upon between the customer and manufacturer.

Bend Test—Samples for bend test shall be straight and not less than 10 in. long. One end of the sample shall be clamped between jaws having their upper edges rounded with 3/16 (0.188) in. radius. The free end of the wire shall be held loosely between two guides and bent 90 deg. over one jaw; this is to be counted as one bend. On raising to a vertical position the count will be two bends. Wire shall then be bent to the other side, and so forth, alternating to fracture. The minimum number of bends required is stated in the attached table.

Wrapping Test—A wrapping test is to be made on at least 10 per cent of the total number of coils offered for inspection at one time. The wire is wrapped around its own diameter eight consecutive turns with a pitch substantially equal to the diameter of the wire and then unwrapped, maintaining the free end at approximately 90 deg. with the mandrel. It must stand this test without fracture. Because of the possibility of personal error in making this test, failure on one test is not considered conclusive, and if required to do so the inspector shall make at least one, but no more than two, additional tests on the sample of wire. If any of these tests are successful, the material shall be passed as satisfactory in this respect.

Selection of Test Specimen—A tensile, a torsion and a bend test shall be made on each end of each piece or coil of wire. When an individual coil of wire is to be divided into smaller coils to meet special requirements, it is sufficient to make one test on the original coil and to cut and seal the small coils in the presence of the inspector.

Dimensions and Tolerances—All wire for this purpose shall be furnished in decimal sizes corresponding to the American Wire Gage (Brown & Sharpe gage).

A permissible variation of 0.002 in. above gage on all sizes will be accepted, but no wire will be accepted having a variation of more than 0.005 in. below gage.

TABLE FOR ROUND HIGH STRENGTH STEEL WIRE

American Wire Gage	Diameter in Inches	Weight in Pounds per 100 Ft.	Number of Bends Through 90 Deg.	Breaking Strength, Minimum Pounds	Tensile Strength in Pounds per Square Inch
6	0.162	7.01	5	4,500	219,000
7	.144	5.56	6	3,700	229,000
8	.129	4.40	8	3,000	233,000
9	.114	3.50	9	2,500	244,000
10	.102	2.77	11	2,000	244,000
11	.091	2.20	14	1,620	254,000
12	.081	1.744	17	1,300	252,000
13	.072	1.383	21	1,040	255,000
14	.064	1.097	25	830	258,000
15	.057	.870	29	660	259,000
16	.051	.690	34	540	264,000
17	.045	.547	42	425	267,000
18	.040	.434	52	340	270,000
19	.036	.344	70	280	275,000
20	.032	.273	85	225	280,000
21	.028	.216	105	175	284,000

Non-Flexible 19 Steel Wire Cable

S. A. E. Recommended Aeronautic Practice

This specification covers high strength 19 steel wire cable used in the construction of aircraft when flexibility is of minor importance.

Manufacture—The steel wires composing the cable shall be laid around the center wire in one or two layers as required by the number of wires in the cable with a left-hand (counter-clockwise) pitch and with a length of lay not to exceed 11 times the diameter of the cable or not less than 9 times the diameter of the cable.

Wires composing the cable shall be uniformly coated with pure tin or galvanized* to solder readily.

Joints in wires composing the cable shall be brazed in a gas fire. Tucked in, welded or twisted joints will not be permitted. No two brazed joints in individual wires shall be closer to one another in the completed cable than 150 ft. All brazed joints in wires shall be tinned. Exposed brass at joints shall not constitute cause for rejection.

Workmanship and Finish—Each length of cable is to be evenly laid and free from kinks, loose wires or other irregularities. The cable shall remain in this condition when unwound from the reel or bent around a standard thimble, proper precautions being taken to secure the ends.

Physical Properties and Tests—Tensile Test—A tensile test shall be made upon each reel of cable purchased of a size.

Samples of cable for testing for tensile strength shall be not less than 24 in. in length. In making tensile tests the distance between jaws of testing machine, with sample in place and before test, shall be not less than 10 in.

Samples for tensile test may be clamped in the jaws of the testing machine in the usual manner to facilitate testing, but in case of failure or dispute on individual tests, and at the request of the manufacturer, check tests shall be made by socketing the samples with pure zinc.

Cable for use in the construction of aircraft shall meet the required breaking strength specified in the table.

Bend Test—One bend test is to be made on a sample cut from each reel of cable of a given size. Each sample must be bent once around its own diameter and straightened again at least 20 times in succession in the same direction of bending without any of the wires breaking.

Torsion Test—A torsion test is to be made on one wire from each sample of cable taken for tensile test. The wire is to be gripped by two vises 8 in. apart. One vise shall be turned uniformly at as high a rate of speed as possible without perceptibly heating the wire. One vise shall have free axial movement in either direction.

The number of complete turns which the wire shall stand is determined by the formula:

$$\text{Number of turns} = \frac{2.2}{\text{diameter in inches}}$$

Failure of one piece of wire to show full number of turns specified in the above torsion test shall not be considered cause for rejection, but in such case two additional tests shall be made on two more wires from the same sample of cable, and if both samples meet the requirements of the specifications the cable shall be accepted in this respect.

Dimensions and Tolerances—There shall be no permissible variation in gage below size. Cable having a diameter of 0.031 (1/32) to 0.156 (5/32) in., inclusive, shall have a permissible variation of 10 per cent above size, and cable having a diameter of 0.187 (3/16) to 0.375 (⅜) in., inclusive, shall have a permissible variation of 7 per cent above size.

TABLE OF WEIGHTS, SIZES AND STRENGTH OF CABLE
English Units

Diameter, Inches	Breaking Strength, Pounds	Approximate Weight, Pounds per 100 Ft.
0.312 (5/16)	12,500	20.65
.250 (¼)	8,000	13.50
.218 (7/32)	6,100	10.00
.187 (3/16)	4,600	7.70
.156 (5/32)	3,200	5.50
.125 (⅛)	2,100	3.50
.109 (7/64)	1,600	2.60
.094 (3/32)	1,100	1.75
.078 (5/64)	780	1.21
.062 (1/16)	500	.78
*.031 (1/32)	185	.39

*7 wire.

*The method of galvanizing, if used, to be specified by customer.

Flexible 6 x 7 Steel Wire Cable

S. A. E. Recommended Aeronautic Practice

This specification covers high strength 6 x 7 flexible steel wire cable used in the construction of aircraft where flexibility is important.

Manufacture—The steel wires composing the individual strands of the cable shall be laid concentrically around the center wire in one layer of six wires with a left-hand (counter-clockwise) pitch or lay. The cable itself shall be constructed by twisting six of these strands composed of seven wires each around a cotton center with a right-hand (clockwise) pitch or lay of 6 to 8 times the diameter of the whole.

Wires composing the cable shall be uniformly coated with pure tin to solder readily.

Joints in wires in cable having a diameter of 0.156 (5/32) in. and larger shall be brazed in a gas fire. In cable having a diameter of 0.125 (⅛) in. or less, wires may be joined either by brazing or twisting, at the manufacturer's convenience. Tucked-in or welded joints are not permitted. No two joints in individual wires shall be closer to one another in the completed cable than 30 ft. All brazed joints shall be tinned. Exposed brass at joints shall not constitute cause for rejection.

Workmanship and Finish—Each length of cable is to be evenly laid, and free from kinks, loose wires or other irregularities. The cable shall remain in this condition when unwound from the reel or bent around a standard thimble, proper precautions being taken to secure the ends.

Physical Properties and Tests—Tensile Test—A tensile test shall be made upon each individual reel of cable purchased of a size.

Samples of cable for testing for tensile strength shall be no less than 24 in. in length. In making tests the distance between jaws of testing machine with sample in place and before test shall be not less than 10 in.

Samples for tensile test may be clamped in the jaws of the testing machine in the usual manner to facilitate testing; but in case of failure or dispute on individual tests and at the request of the manufacturerer check tests shall be made by socketing the samples with pure zinc.

Cable for use in the construction of aircraft shall meet the required breaking strength specified in the table.

Bend Test—One bend test is to be made on a sample cut from each reel of cable of a given size. Each sample must be bent once around its own diameter and straightened again at least 20 times in succession in the same direction of bending without any of the wires breaking.

Torsion Test—A torsion test is to be made on one wire from each sample of cable for tensile test. The wire is to be gripped by two vises 8 in. apart. One vise shall be turned uniformly at as high a rate of speed as possible without perceptibly heating the wire. One vise shall have free axial movement in either direction.

The number of complete turns which the wire shall stand is determined by the formula:

$$\text{Number of turns} = \frac{2.2}{\text{diameter in inches}}$$

Failure of one piece of wire to show full number of turns specified in the above torsion test shall not be considered cause for rejection, but in such case two additional tests shall be made on two more wires from the same sample of cable, and if both samples meet the requirements of the specifications the cable shall be accepted in this respect.

Dimensions and Tolerances—There shall be no permissible variation in gage below size. Cable having a diameter of 1/16 to 3/32 in. inclusive, shall have a permissible variation of 12 per cent above size; cable having a diameter of ⅛ to 3/16 in., inclusive, shall have a permissible variation of 10 per cent above size, and cable having a diameter of 7/32 to ⅜ in., inclusive, shall have a permissible variation of 7 per cent above size.

(To be continued)

British Aircraft Engine Inspection—II

Ideal Firm's Inspection Procedure, with Reference to the Manufacture of a Cylinder for a Rotary Engine—Production of Aluminum Pistons and Crankshafts

By Col. Bagnall-Wild

1. Assuming that the specification for the material is mild steel, 0.4 to 0.5 carbon to conform to specification.

2. The main contractor orders rough machined forgings from the sub-contractor X. (whose method of manufacture the main contractor has approved). These forgings are to be supplied in the annealed condition, and samples of the test pieces from the bar material of which the stampings are made, to be supplied.

3. Sub-contractor X. orders approved material from sub-contractor Y., who is a steel manufacturer, and quotes the approximate analysis which he considers desirable to meet the conditions required in the manufacture of commercial forgings, and which will be in accordance with specification. He also asks for a copy of a test certificate of the material taken at some approved test house.

4. The forgings made by sub-contractor X. are delivered to the main contractor, who arranges the machining of the stampings through the various operations, until the cylinder is completed and ready for fitting to the engine. The inspection arranged for by an ideal firm in their own works, and in agreement with the sub-contractors in their works, would probably be as follows:

A. Steel Manufacturer Y. The cast or casts of the steel which the contractors propose to supply are analyzed; each ingot of the steel is examined, and an inspector decides the amount of cropping necessary from each end. The cropped ingot is then passed through to the rolling mills, where it is hammered and rolled into suitable bars. Inspection of the bars is made for roakes, pipes or seams, and all defective material is rejected.

During the manufacture, inspectors check and record the temperature of rolling and working.

A sample test piece is cut from the bar and forged down to the ruling dimension of the shell of the cylinder forging.

This test piece is then normalized, and tests are carried out at an approved test house; if all the bars are made from one cast, probably one or two test pieces only will be taken.

A copy of the certificate will be forwarded to contractor X., with possibly some spare test pieces; the bars will then be delivered to the forging firm.

B. The forger X, on receipt of material with a certificate, will immediately put in hand the forgings of the cylinder shells; inspectors will arrange to check the temperatures of working throughout the whole process.

On completion each cylinder shell will then be annealed, the temperatures being carefully checked and each forging Brinelled. A sample of the material will be hammered down to the ruling dimension of the shell, and will be annealed at the same time as the forging. This sample piece will then be machined as a test piece and Brinell and tensile tests taken.

The Brinell numbers of all forgings should conform to a definite range, based on the test piece, and, providing the tensile figures of the test pieces are satisfactory, the forgings will be approved.

They will then be passed to the rough machining shop, and the skin removed, care being taken to retain the identity numbers.

After inspection for surface flaws and general dimensions they will be passed for delivery to the main contractor.

In the main contractor's works the stampings will then be passed to the various machines for the remaining operations, inspection taking place between each operation as per the following schedule:

1. Rough turn on outside to chuck jaws, rough drill or bore, and face end.
2. Rough counterbore working barrel, rough turn outside to chuck jaws, face end, rough bore valve seat diameter, bore working barrel, finish internal coned head, rough form outside taper.
3. Rough bore and recess for valve thread, rough turn outside diameters, face to overall length, form top angular face.
4. Mill flat for sparking plug boss.
5. Rough form fins.
6. Anneal and sand blast.
7. Turn tops of fins, finish form first 9 fins, finish tops of first 9 fins and polish.
8. Drill hole for sparking plug boss.
9. Chamfer mole, and weld in sparking plug boss.
10. Finish bore working barrel, chamfer mouth of bore.
11. Form diameter at crankcase end, face shoulder and form grinding recess, form remainder of fins, finish valve thread recess, polish remaining fins.
12. Cut valve thread.
13. Slot-mill keyway, slot castellations.
14. Drill oil holes.
15. Grind crankcase register.
16. Grind working bore.
17. Balance cylinder.

Before final finishing the cylinders will be annealed to remove machining stresses. Final machining will be carried out, in order to bring the cylinders within the standard weight limits, and in addition to adjust the center mass of the cylinder to the right position.

Inspection will be carried out on the finished cylinder for all final dimensions, weight and center of mass.

The inspection as arranged by a government department, assuming that they have no control or are not aware of the contractor's inspection, will be as follows:

(a) The ingot from which the bars will be made at the steel manufacturers' would be inspected and particulars of ingot and analysis of the cast taken. During the rolling of the material the temperatures of the rolling will be taken occasionally. The complete bars will be submitted for inspection, and will be checked for dimensions in accordance with the standards or particulars of the order. One test piece for every 20 bars will be taken, and after working down will be normalized and a test carried out. Each bar will then be Brinelled, and if within a satisfactory agreement the bars will be passed on the results of the test piece, and a certificate and release note issued.

(b) On receipt of stampings the material will be inspected and checked against the release note. The operations will be periodically inspected, a check of the temperatures being taken from time to time. The samples of the material will be taken, and after working down to ruling dimensions will be heat-treated with the stampings, a test piece representing each batch of stampings being supplied. The stampings will then be inspected for dimensions in order to insure that sufficient material is available to allow for cleaning up.

Each stamping will then be Brinelled, and if the test piece is satisfactory and the Brinnels are reasonably consistent the stampings will be passed after general inspection for flaws, etc.

(c) On receipt at the plant of the main contractors the forgings will be checked by the release note and released to the machine shops. No further inspection will be carried out beyond the transference of the stamping number. The finished cylinder can then be identified with an individual stamping. The finished cylinder will be inspected for all dimensions, weight and center of mass, and if satisfactory will be stamped and approved.

The action which a government inspection department would probably take with the ideal firms would be as follows:

(a) The checking of the analysis of the cast would be taken, and periodical checking of the firm's own inspection would be made as regards rolling temperatures, working, etc. The test pieces would be pulled and material passed under the usual procedure.

(b) At the forging works periodical checking would be made of working temperatures, and check test of the heat-treatment made periodically at random, and Brinell report for each stamping examined.

Cylinders would be selectively examined for flaws and general dimensions, and finally accepted and released to the main contractor.

The main contractors' inspection fixtures would be examined, periodical selective check testing being made between operations, and also of the finally finished article.

Should any defects be discovered the whole of the batch concerned would be examined in detail; otherwise only selective examination would be made.

On final erection of the cylinders into the engine a check examination would be made to see that the various fits are satisfactory, and should any of these points show discrepancies a detailed examination would be made of all stock in the stores. All spares, unless erected in the engines at the main contractors, would be examined in detail for the dimensions affecting the fit, functioning, or the strength of the part.

SYSTEM OF PRODUCTION OF CAST ALUMINUM PISTONS

When casting, three test pieces are cast for every eight pistons. The pistons are numbered when taken from the sand, and the test pieces, removed in the fettling shop, are sent to the experimental department for tensile test and chemical analysis.

If these tests are satisfactory and approved by the government inspectors the pistons are released and pass into the foundry view room.

Here they are inspected for blowholes, and the inside diameter of the barrel is calipered for size: the correctness of position of the gudgeon pin hole is also tested on the surface table. If approved they pass from this room into the casting store.

The store issues them to the machine shop on a machining order, and in this shop they go through the following operations:

1. Rough machining outside, both on sides and crown. Viewed at site of lathe for blowholes, etc.
2. Finishing turning on sides and crown, leaving only enough metal for grinding operation.
3. Bored at mouth and faced down to correct depth from inside crown.
4. Rough drilling of wrist pin hole to 1 in. and facing bosses inside.
5. Cutting and rolling two ring grooves and scraper ring groove.
6. Drilling hole for set pin.

They now pass into the grinding shop for the seventh operation.

7. Grinding true to size on the outside diameter.

They then return to the machine shop for the following operations:

8. Finishing facing and rolling crown.
9. Milling oil groove.
10. Finishing boring gudgeon pin hole.

They then pass in the machine shop test room, where in operation

11. They are tested under 10 lb. per sq. in. water pressure.

At this point they again return to the machine shop for operation

12. Burnishing wrist pin hole.
13. Drilling drain holes around scraper ring groove.
14. Number rolled on.

After all operations from the second to the fourteenth they are taken to the section view table for inspection and finally are weighed, have the weight stamped on them and then are

15. Polished on crown.

This completes the machine shop operations and they pass into the final view room before going into the finished store, accompanied with a view note. This view note bears the chief inspector's stamp, without which the pistons would not be inspected in the final view room.

The finished stock then issues them to the assembly shop, where they are fitted to the connecting rods, etc., the operations being:

16. Rings fitted on and lapped.
17. Assembling with connecting rods.

They are then finally viewed, tested for correct weight and passed on to the charge hand, who again inspects them generally all over before he allows them to be assembled with an engine.

After assembling in the engine they pass on with the engine to the test bench and then after engine test to the stripping shop, where they are very carefully examined for scoring and wear on rings, etc., and the wrist pins removed and replaced before they are again assembled with the engine for the final test. If this test is satisfactory the engine then passes on to the dispatch shop for dispatch.

SYSTEM OF PRODUCTION OF ENGINE CRANKSHAFT

The crankshafts are stamped in Sheffield, have test pieces cut from the ends of the shaft, and are tested there before being approved and released by the government inspector for dispatch to contractors.

They are issued by the contractors' stores to the machine shop on a machining order, where they go through the following operations:

1. Center shaft.
2. Saw off test pieces and stamp number in the presence of the inspector.
3. Re-center.
4. Rough turn journals, ends of shaft and faces of webs, leaving enough metal for grinding.

Viewed at section view table.

5. Number restamped on side of web.
6. Milling sides of webs for locating purposes.

Viewed at section view table.

7. Milling sides of webs parallel.
8. Turning crankpins and facing webs for grinding.

Viewed at section view table.

9. Form mill radius at crankpin and journal ends.
10. Grind radius.

Viewed in main view room.

11. Drilling and tapping holes through crankpin.
12. Drilling through center of crankshaft.

Viewed in main view room.

13. Hand tap crankpins for oil plugs.
14. Turn journals and taper shaft for grinding.
15. Turn chamfer on radius and cone inside ends of hole through shaft.

Viewed in main view room.

16. Grinding two ends of shaft for locating purposes.
17. Grinding pins and faces of webs.

Viewed at a second section view table.

18. Number transferred to chamfer on radius.
19. Grinding journals, taper end of shaft and faces of webs.

Viewed at second section view table.

20. Grinding edges and radius of webs.

Viewed at second section view table.

21. Milling castellations.
22. Milling keyway on taper end of shaft.
23. Filing castellations to fit gage.
24. Milling driving slot at end of shaft.
25. Frazing webs.
26. Screw threads cut on both ends.
27. Drilling holes for balance weights.
28. Drilling and countersinking oil holes in crankpins and journals.

Finally viewed all over in main view room and component number stamped on.

The crankshafts now pass into the finished store on a view note, from whence they are issued to the assembly shop, where they undergo the following operations:

29. Tapping and plugging oil holes in journal ends.
30. Plugs removed, oil holes drilled through them, replaced and setpins inserted in ends of these oil holes.
31. Balance weights fitted.

Viewed for balance on a third section view table, and numbered as viewed.

Oil ways tested under pressure of 200 lb. per sq. in. with lubricating oil.

Stamped with viewer's number.

32. Key fitted to keyway in taper end.

Viewed for the taper and keyway at vice.

33. Main ball races fitted.
34. Bevel gear and locking nut fitted.
35. Taper gear, end ball race and locking nut fitted. Final viewing, length between housings of journal bear-

(*Concluded on page* 199)

Reasons Behind the Class B Engine

A Technical Analysis of Its Design by One of the Engineers Associated in the Work—Bearing Pressures Shown by Diagrams—Performance of the Engine in Tests

By A. F. Milbrath*

IN the early stages of standardization of military truck design it was the idea to limit the interchangeability of parts to the complete units, such as engines, axles, transmissions, etc. Several meetings of parts makers were held, with a view of determining the degree to which their regular products could be standardized, so as to make them interchangeable in the chassis.

In the case of the engines it was found that a standard set of installing dimensions could be determined, which necessitated only slight changes for the various manufacturers. This would have made it possible to replace a damaged unit with one of another make, in case none of the original type were available.

However, the farther this work progressed the more important it was considered by the War Department to have not only complete units interchangeable but all of the component parts of the units as well. It is obvious that this plan would greatly reduce the list of parts necessary for maintenance of the trucks at the front. When this decision had been made the engineers of various parts manufacturers were called to Washington to work up suitable designs to meet the requirements of the Government.

Torque and Piston Displacement

The division in charge of engine design was required to develop an engine with an output of at least 2800 in.-lb. torque, which was necessary to give the tractive factor predetermined for these trucks. An average of the performance of various engines built in the past showed a torque of about 6¾ in.-lb. per cu. in. piston displacement. Using this figure as a basis, the piston displacement of the Class B engine was determined at about 415 cu. in. Possibly the most important consideration in the designing was that of keeping the wearing parts of these engines very large so that adjustments and replacements of parts would be required but seldom.

Bore and Stroke

In arriving at the bore and stroke of this engine it was considered desirable to keep the ratio as high as possible, without obtaining too great a total weight of engine or too great a height over all. It was therefore the length of stroke which was the determining factor in the stroke-bore ratio. After a few sketches had been made of various ratios, a 6-in. stroke was finally adopted. This with a bore of 4¾ in. gives a piston displacement of 425 cu. in.

Engine Speed and Valve Diameter

The normal speed of these engines was set at 1050 r.p.m., which with the 6-in. stroke would give a piston speed of 1050 ft. per minute. The speed of maximum horsepower was also predetermined at about 1500 r.p.m. From past practice it was shown that the maximum horsepower of an engine was developed at a speed at which the theoretical gas velocity through the valves was about 14,000 ft. per minute. Assuming an engine speed of 1500 r.p.m., the valve area should therefore be $(4\frac{3}{4})^2 \frac{11}{4} \times \frac{1500}{14000} = 1.9$ sq. in.

This requires a valve 2⅛ in. diameter in the clear, 2⅜ in. outside diameter, 45 deg. seat, with a lift of 11/32 in. At the normal engine speed this will give a gas velocity of 160 ft. per second through the valve.

Compression Ratio

With the heavier grades of gasoline in use at the present time the compression must be carried somewhat lower than was possible a few years ago, otherwise serious pounding will result in the cylinders. The displacement per cylinder also has some effect on the compression, since a larger cylinder has a smaller wall surface cooling effect per cubic inch of charge than a smaller engine. The past experience of the designers was again called upon, and from this a clearance volume of 24½ to 25 per cent of total volume was determined upon. This clearance will give a compression of about 65 lb. gage at slow cranking speeds.

Connecting Rod and Piston

The connecting rod of the military engines as compared with regular practice might be considered of the long type, it being 13¼ in., or 2.21 times the length of stroke, the standard practice varying from about 2 to 2.2 times stroke. Both upper and lower bearings are laid out central with the rod. The rod is of the I-beam section and the upper end is bronze bushed for the piston pin, while the lower end is of the four-bolt type.

The piston is 6⅛ in. long, with three ¼-in. rings of the conventional type with 45-deg. saw cut. The piston pin is 1⅜ in. in diameter and is located 2⅝ in. from the lower end of the piston. A single lockscrew holds the piston pin in place. This lockscrew passes through both sides of the piston pin and piston boss, the lower end of the screw being threaded into the piston boss, while the reduced body size of the screw fits into the upper wall of piston pin and boss. The bushing in the upper end of connecting rod is 2⅛ in. long, giving an area of 2.92 sq. in. At low engine speeds, when subjected to gas pressures only, this bearing sustains a pressure of 1700 lb. per sq. in. maximum. At 1500 r.p.m. the greatest pressure due to inertia and gas forces is 1200 lb. per sq. in.

Crankshaft

As the crankshaft is the backbone of an engine, considerable thought was given this important part. It is of the conventional three-bearing type. While the governed speed of the engine was to be 1050 r.p.m., it was desired to keep the stresses and bearing pressures low even at 1500 r.p.m. All calculations were therefore made at this higher speed. The stresses considered were three: Those due to gas pressure, to inertia, and to centrifugal forces, as shown in Fig. 1 for one position of crankshaft on the power stroke. These forces as affecting the crank pins are given in Fig. 2. The normal gas pressure at the beginning of the power stroke is assumed to be 280 lb. gage, and the expansion curve to follow the equation $p\ v^{1.3} = \text{constant}$. In the calculation of inertia forces the reciprocating weight was taken at 10 lb. and included the piston, which weighs 6¼ lb., and the upper end of rod with wrist pin, weighing 3¾ lb. The centrifugal force is set up by the lower end of rod with bearing, weighing 5½ lb.

In the diagram the forces acting during the suction stroke are represented by dotted lines, those acting during the compression stroke by dashed lines, during the power stroke by

*Paper scheduled for S. A. E. winter session.

solid lines and the exhaust by dot and dash lines. In laying out these forces it was assumed that the gas pressure during the suction and exhaust stroke was atmospheric. The lines representing forces during the lower end of the exhaust stroke are not shown, as they practically coincide with the lines representing the compression forces. It will be noted that the greatest pressure exists at the end of the exhaust or beginning of the suction strokes; also, that with the exception of the first part of the expansion stroke, all pressures are outward from the center of the crankshaft.

The crank pins of the Class B engine are 2⅜ in. in diameter and 3 in. long. Deducting for fillets at each end, this gives a projected area of 6.53 sq. in. The maximum pressure on the pins is 520 lb. per sq. in., the minimum 160 lb. and the mean 330 lb. At 1050 r.p.m. the centrifugal and inertia forces are: $1050^2/1500^2$, or 49 per cent of the forces at 1500 r.p.m. At this speed the forces due to gas pressure on the expansion stroke predominate. The maximum crank pin load is then 512 lb. per sq. in., while the minimum and mean are somewhat less than one-half the loads at 1500 r.p.m.

In the calculation of main bearing pressures there must be added to the above forces the centrifugal component of the short crank arm and crank pin. Fig. 1 gives the resultant of the forces acting on the main bearings. These forces are due to gas pressure, inertia and centrifugal forces from one cylinder, one set of reciprocating parts and one crank pin and short crank arm.

In order to keep down the number of spare parts, only two sizes of bearings are used on the crankshaft. The connecting rod and front main bearings being interchangeable, likewise the center and rear main bearings, which are 2½ in. in diameter and 4 in. long; allowing for fillets, this gives a projected area of 9.375 sq. in. The maximum pressure on the front main bearing is 727 lb. per sq. in., the minimum 32 lb. per sq. in. and the mean 509 lb. The center bearing takes the load from two cranks at the same time. When No. 2 cylinder is on the suction stroke No. 3 is on the power stroke; when No. 2 is on compression No. 3 is exhausting, and vice versa. The forces from the two must therefore be combined to obtain the pressure on the center bearing. The result is a maximum pressure of 903 lb. per sq. in., a minimum of 485 lb. and a mean of 695 lb. per sq. in. The rear bearing carries about the same load as the front, plus the weight of the flywheel. The flywheel load, however, is almost negligible, as it amounts to less than 15 lb. per sq. in. The maximum pressure on the rear main bearing is 492 lb. per sq. in., the minimum 38 lb. and the mean 355 lb. At 1050 r.p.m. the main bearing pressures are also considerably less than at 1500 r.p.m.

As might be expected, due to the liberal dimensions of crank pins and main bearings, the fiber stresses in the shaft are low. The crank arms are designed heavy also, in proportion to the pins, so that the maximum stresses, due to combined torsion and bending, are under 10,000 lb. per sq. in.

Cylinders

The cylinders are cast in pairs, of the L type, with valves on the right side. The heads are removable and held in place by 13 ½-in. studs. The valve stems are inclosed by pressed steel cover plates. The water jackets are very liberal, tapering from ½ in. below to 1¼ in. above. The spark plugs are screwed directly into the cylinder heads and the plugs are entirely surrounded by water. Cooling water enters the jackets at the lowest point and leaves the heads at the highest point. Thus no drain cocks are necessary, the entire cooling system draining from one point.

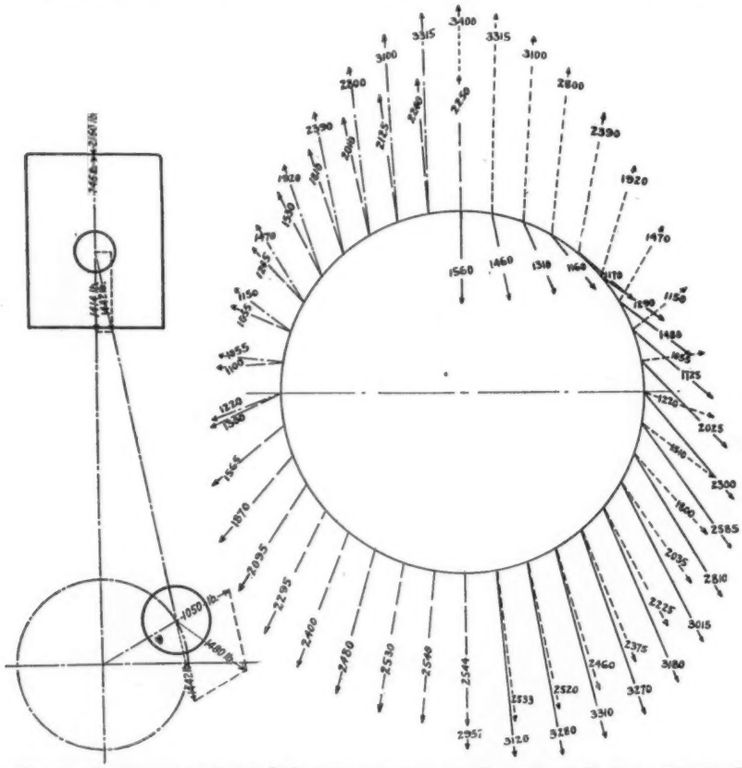
Crankcase

The crankcase is cast of aluminum, and it is very deep and well ribbed. The parting line between the upper and lower half is 3 in. below the center line of the crankshaft.

The fly wheel is inclosed in a No. 3 S. A. E. bell housing. Three-point suspension is employed, two arms cast onto the bell housing and a trunion bearing on the front gear cover. Shouldered studs with castle nuts are used for attaching the cylinders. Provision is made for the mounting of electric starters, and generators are mounted as regular equipment. The front gear cover is of cast iron, and on account of its acting as forward support it is well ribbed. The lower crankcase forms the pan and it entirely incloses the oil pump.

Camshaft and Gears

The camshaft is drop forged with integral cams and flange for mounting of the driving gear. The cams are 1⅜



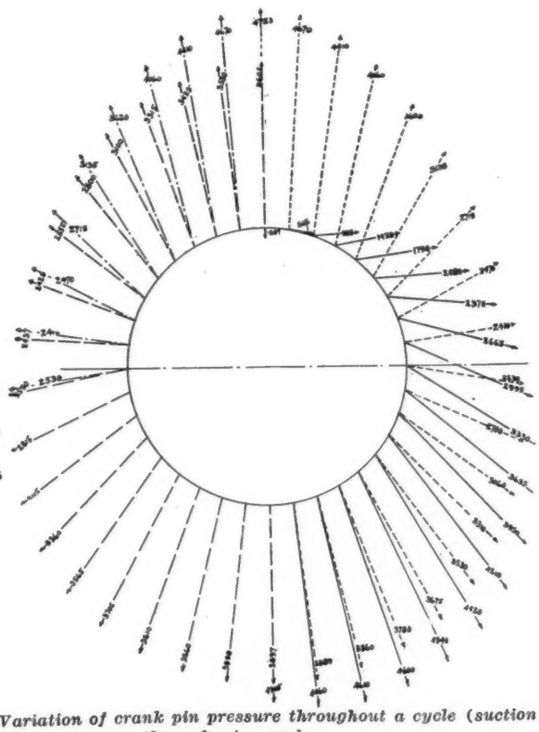


Fig. 1—Components of crankpin pressure at a crank angle of 60 deg. Fig. 2—Variation of crank pin pressure throughout a cycle (suction stroke pressures dotted). Fig. 3—Variation of main bearing pressure throughout a cycle

in. in diameter, with 11/32-in. lift. The timing is as follows: Inlet opens 15 deg. past top center and closes 35 deg. past lower center; exhaust opens 45 deg. before lower center and closes 5 deg. past top center. The camshaft bearings are a trifle larger than the cams, so the shaft can be easily withdrawn.

The timing gears are 1¼ in. wide, teeth cut on an angle of 27¼ deg. — 9 pitch. The drive is from the crankshaft gear through an idler to the camshaft and water pump gears, and from the camshaft to the generator drive gear.

The valve tappets are hollow, 1⅛ in. in diameter, of the roller type. They carry adjusting screws 1 in. in diameter, also bored hollow.

Oiling System

The oiling system is of the force feed type, embodying a gear type circulating pump. No oil pipes are used, the oil being forced through a passage drilled in the pump body to a header extending the full length of the crankcase, then through drilled passages to the main bearings. Grooves are provided in the main bearings, which constantly communicate with the oil holes drilled through the crankshaft to the connecting rods. Oil tubes on the connecting rods lead oil to the piston pins. A relief valve set for 10-lb. pressure is fitted to the front end of the main oil header, and the overflow from this valve lubricates the gears.

The oil pan or lower half of the crankcase is so formed that the oil will drain toward the center of the sump, even though the engine is inclined, as in climbing or descending a hill.

The oil drains from the crank chamber through a spout into a settling chamber, where any water and mud settles, and can be drained off from time to time. As the oil rises in the settling chamber it finally overflows the top into a large strainer, which completely surrounds the settling chamber. Through this strainer the oil flows by gravity into the sump proper. The oil pump is supported from the upper crankcase and extends down into the sump. Another strainer surrounds the oil pump, so the oil is quite thoroughly cleaned. No parts except the settling chamber and large strainer are attached to the lower half of crankcase, so this can be dropped by taking out the bolts, without interfering with anything else. No oil float of any kind is used, but a graduated test rod is fitted, which can be withdrawn to ascertain the amount of oil in the engine.

Ignition

Two entirely independent systems of ignition are incorporated: a high tension magneto, which is driven off the rear end of the water pump shaft; and a combined timer and distributor with coil mounted at the forward end of the engine, on the left side, and driven through helical gears from the water pump drive shaft. Two sets of spark plugs are fitted into the heads of the cylinders, and the engine can be run on either one or both of the systems.

Manifolds

The inlet and exhaust manifolds are on the right side of the engine. A heating chamber is cast integral with the inlet manifold near the center, where the vertical branch from the carbureter joins the horizontal section. This heating chamber bolts directly to the exhaust manifold at a point where an opening is cast in it, so that the hot gases can circulate around the inlet manifold. This forms a hot spot about 4 or 5 in. long, which helps to vaporize the fuel, and permits the use of low grades of gasoline.

Fan

A 22-in. fan, especially designed for these trucks, after a long series of tests, is mounted on a rigid bracket, bolted to the crankcase. The fan is provided with a vertical adjustment for taking up the slack in the belt. This, however, will be necessary but seldom, as a 2-in. belt and large pulleys are fitted, which will drive the fan when set up with only a slight tension.

Governor

An entirely inclosed governor, driven off the forward end of the generator shaft, is built into the engine. The centrifugal members of this governor consist of four 1-in. steel balls, held in place by a spider.

On their outward movement these balls travel against the face of a 45-deg. disk, which also gives the balls a longitudinal movement against a collar free to slide on the governor shaft. The collar has a movement of 3/16 in., which is transmitted through a vertical lever, multiplying the movement three-fold. A link with ball joints connects the upper end of the lever with a throttle spindle in the inlet manifold. A spring is fitted to the vertical lever, and an adjustment with a seal is provided. The governor revolves at about one and one-half times engine speed, and the thrust from the balls is 34 lb.

Performance Curves of Class B Engine

Performance curves have been plotted of one of the first engines built. From these it is seen that the maximum torque is developed at 800 r.p.m., and is equal to 258 ft.-lb., or 3096 in.-lb.

With a piston displacement of 425 cu. in. this gives: $3096/425 = 7.27$ in.-lb. torque per cu. in. displacement.

Fuel consumption is given for one-quarter, one-half and full load.

The maximum horsepower would be developed at 1550 r.p.m.

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Variation in Rate of Climb

As the altitude attained by an airplane increases the rate at which it can climb decreases. The relations are similar to those in an automobile picking up speed. The acceleration is a maximum at or near the start from rest, decreases as the speed increases and becomes nil when the car attains its maximum speed. It is obvious that when an airplane reaches its "ceiling" its climbing rate is zero.

A writer in *Flight* has investigated the relation between altitude, rate of climb and time. If h be the altitude at a time t and H the ceiling of the machine, then

$$h = H\left(\frac{1 - e^{\frac{T}{t}}}{}\right)$$

where e is the base of the natural system of logarithms. The rate of climb is obtained by deriving the first differential coefficient of the expression for the altitude with relation to the time.

$$\frac{dh}{dt} = \frac{H - h}{T}$$

This shows that there is a straight line relation between the altitude and the rate of climb. In the above equation T represents what may be called the time constant of the machine, which is equal to the time it requires to rise to 0.632 of its ceiling.

It is shown that the "ceiling" H of a machine may readily be found from the altitude h, reached in time t and the altitude h_2 reached in 2t.

$$H = \frac{h_1}{2 - \frac{h_2}{h_1}}$$

By means of these equations curves can be calculated showing the variation of the altitude and the rate of climb with time.

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Luxury Would Limit Output

The automobile has, in the truest sense, been one of the great inventions of civilization. It has altered for the better conditions of life in almost every country on earth. Yet all the time it was doing this it was being designed for pleasurable performance rather than for the useful work which formed the major reason for its existence.

If motoring was merely a luxury now, as it used to be 15 years or more ago, then the annual output of cars in America would perhaps be 100,000 or less. The world has taken a luxury offered to it and used that luxury as a necessity.

Design of Military Truck Axles

Engineering Description of Front and Rear Axles of Class B Military Worm-Driven Truck—Reasons for Choice of Parts and Dimensions

By G. W. Carlson*

WHEN the Government first summoned the engineers to Washington to design a United States army truck, the axle engineers were divided into three groups, representing worm, internal gear and double reduction type of final drive. The program was to design and build two or more of each type. These were then to be tested, and the type to be adopted was to be based upon the all-around performance as shown by the tests.

The limited time, however, upset this procedure, and it became necessary to make a quick decision, at least in the case of the Class B design. It is not necessary to here discuss the purpose the War Department had in view in its selection of the worm type for the Class B axle. Suffice it to say that the wide use of this type as well as the production conditions were large factors. The question of performance and absolute reliability through critical periods eliminated all inclinations on the part of the engineers to introduce features of an experimental nature.

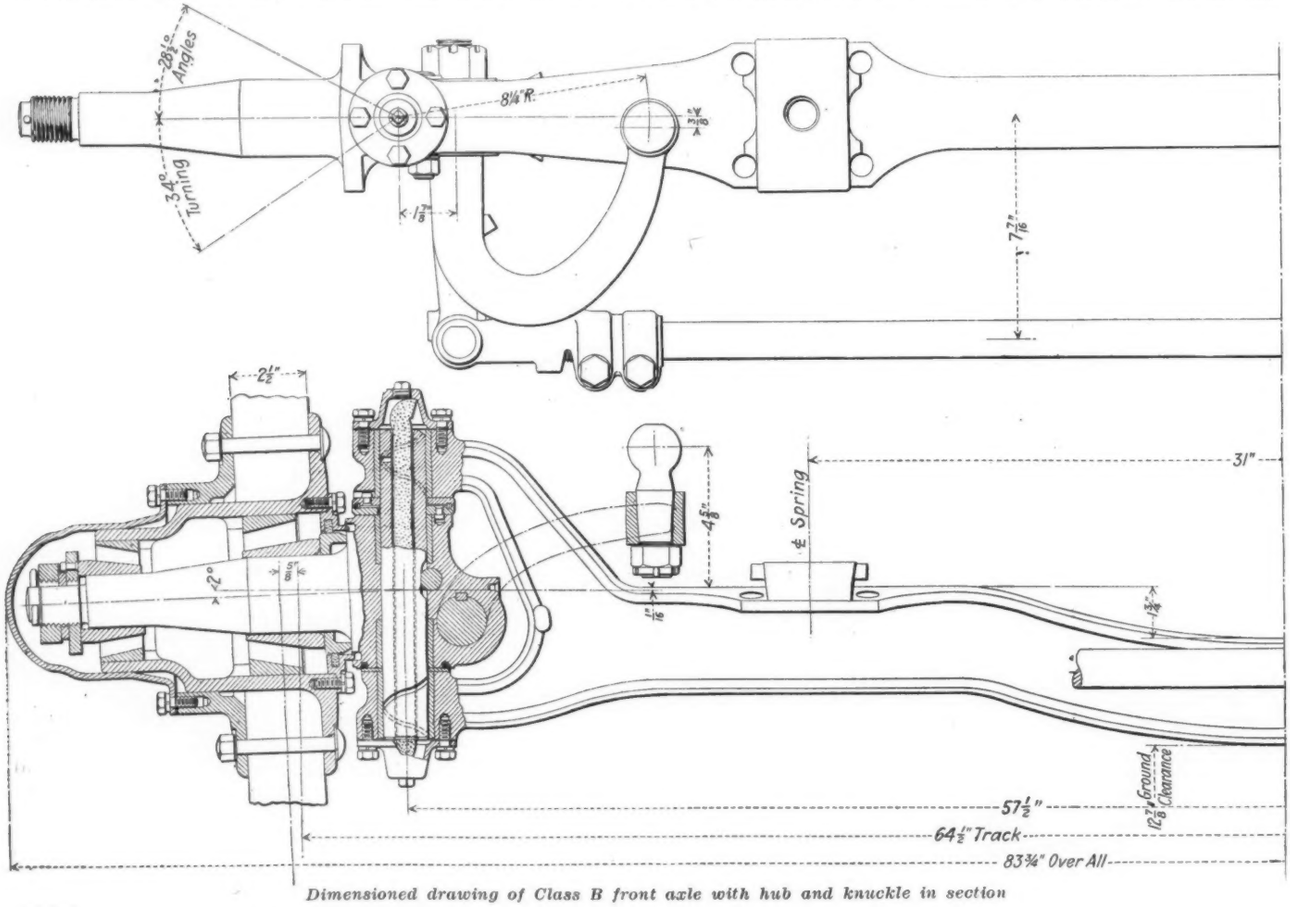
An instance of the latter is manifested in the Class B axles particularly, in which only three bearing sizes are used in the front and rear—the front inner bearing interchanging with the worm bearings—the rear wheel bearings being alike and interchanging with the differential bearings, and the front wheel outer the only odd size. The front carries only one size of screw, a total of forty-four being used. Such is also the case in the rear, where the only right and left-hand parts are the wheel-spindle nuts and the brake anchors. The brake levers, brake shafts, shaft brackets and toggles are all interchangeable.

Front Axles

The Class A and B front axles are, except for proportionate dimensions, the same. The hub closure is designed with the object of presenting the smallest diameter for the felt rubbing face. A flange on the felt retainer rotating within a groove in the knuckle prevents the dirt from reaching the felt, and an additional groove immediately outside the felt is intended to divert any water reaching it, except possibly at the bottom.

Particular attention has been paid to the lubrication of the knuckle pin. This is made of carbon steel, hardened and ground; the bushings being of similar material and pressed into the ends of the center forging, this construction providing a wide bearing spread. The hollow pin contains an oil wick, the ample dimensions of which allow for a generous supply of oil.

Since the ordinary grease commonly used for lubricating this particular place leaves much to be desired, it was argued



Dimensioned drawing of Class B front axle with hub and knuckle in section

*Paper scheduled for S. A. E. winter session.

that even at the expense of considerable leakage oil would be preferable. The experience with the samples is ample testimony of the soundness of this reasoning.

The thrust washers are grooved, the oil entering through recesses next to the pin. The dust device consists of a brass ring floating in opposite circular grooves in the washers. The bottom of the knuckle is closed by means of a similar expanding ring. These rings are intended more to keep out the dirt than to keep in the oil.

The cross tube end pins are fastened to the arms in order to allow for the maximum bearing surface with minimum weight. A draw key is used for this purpose. The bushings are pressed into the end forging. The lubrication is by oil. No attempt is made to hold the oil, a self-feeding oiler being used.

The regular Elliott type was chosen because of the opportunity it presented of bringing the pivot centers close to gage line, and because it was a simpler manufacturing proposition.

The center forging material is No. 1035 S. A. E. steel, heat treated; the knuckles and arms No. 3130 S. A. E. steel, heat treated; hubs and flanges, malleable iron. In short, the S. A. E. materials and heat treatments are used wherever possible.

The steering-arms are forged to shape, except for a hand-bending operation on the ball arm. They are secured in the knuckles by taper fits of generous dimensions, and keyed in place.

The Class AA front axle is of similar type, without the refinements of detail used in the A and B designs. This was necessary because of the limited weight allowed for the lightest axle. The general construction is distinctly passenger type. The lubrication is all with grease, the limitations imposed, as before stated, not permitting a design suitable for oil without approaching features of an experimental nature.

The hubs, unlike those of the two heavier types, are of pressed steel, which embodies the necessary strength with additional lightness. The material is otherwise the same as for the A and B, part for part.

Class B Rear Axle

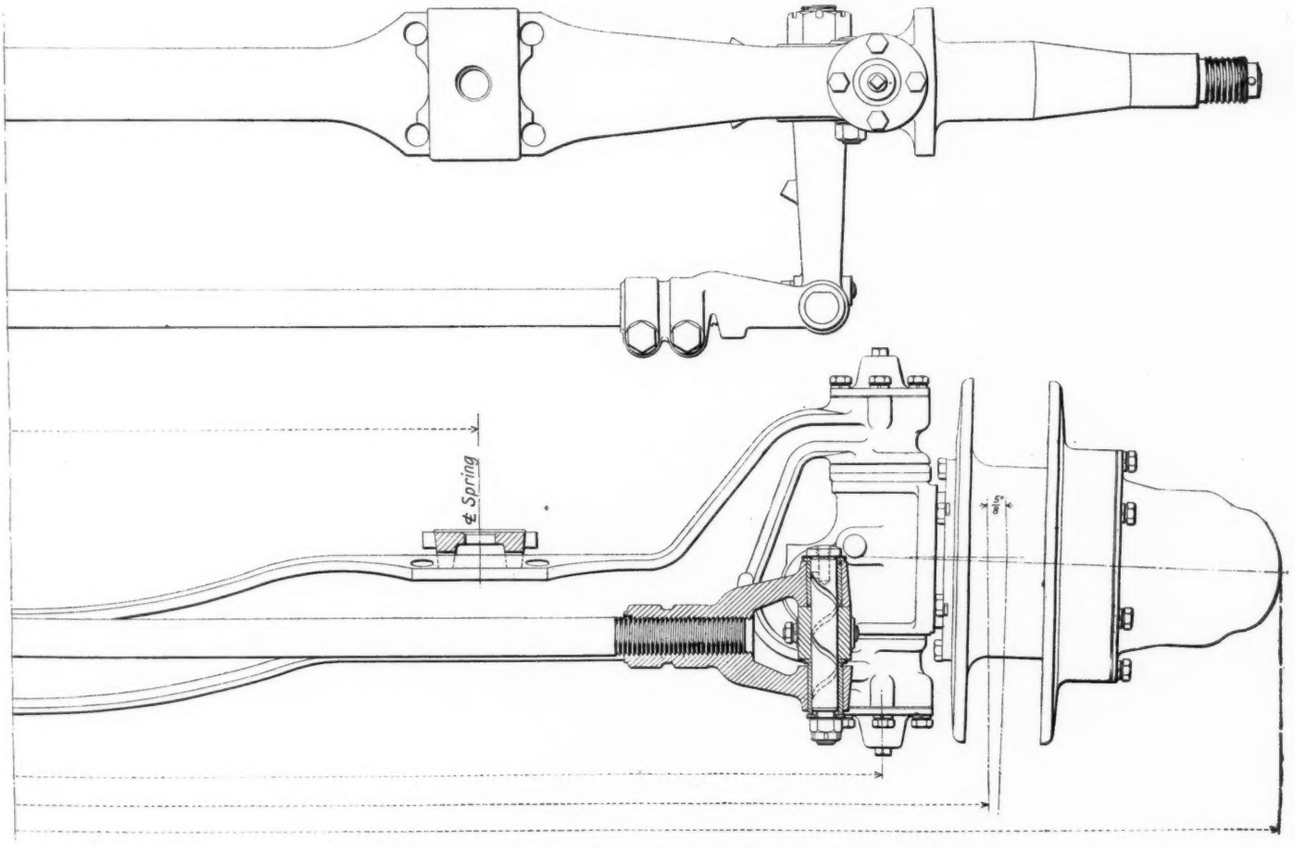
During the early stage of development of the Class B truck, it became apparent that the weight would far exceed that of the commercial 3½-ton truck. This, coupled with the severity of service, brought about a design which, for strength, compares favorably with the average 5-ton commercial rear axle. The weight alone, however, was not the only determining factor. The War Department specification for the locking differential necessitated a shaft diameter of a size that put the bearings and tubes into the 5-ton class. It was not considered safe to calculate the shaft stresses except by the engine torque. The material in the shaft was chosen of a steel such as would present the least uncertainty in heat treatment.

These conditions made it possible, without any sacrifice, to use one size of bearing for the wheels and differential. The drive-plates are shrunk onto the shafts (ten splines being used in each end) and piloted into the hub flange, to which it is secured by fourteen ½-in. bolts. Studs were considered, but through bolts were given preference.

The housing construction is of a Timken type, either cast or forged steel, with a square section from the center bowl out; the tubes are pressed into place, a retaining screw being provided for safety. The tube extends to the bowl of the housing, and a reinforcing plate is fitted over the inner end and riveted or welded to the top and bottom of the housing shell.

The forged steel spring-seats are in two parts—top and bottom—each fitted over the housing on machined surfaces and doweled for side position.

The worm and gear are of the David Brown type, with an 8⅝-in. center distance. The pressure angle is 30 deg., the linear pitch 1.1562 in., and the lead angle is 24 deg. 20 min. Compared with the sizes used in commercial trucks, this design appears somewhat inadequate. The limiting



Two views of the Class B front axle with the tie rod yoke in section

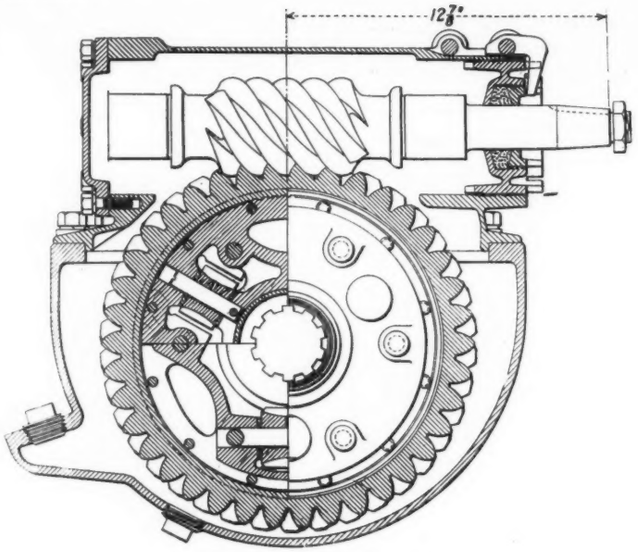
factor, however, is ground clearance, which the military authorities considered so necessary as to sacrifice possibly the maximum life of the worm gear. It might be mentioned that the samples, giving due consideration to the comparatively short mileage, do not indicate that such a sacrifice has been made.

The gear is mounted onto the differential by means of comrigations 3.16 by 1/16 in. on one side for one-half the width of the gear seat and piloted by the other side. It is secured against side thrust by a ring held by twelve rivets and against a shoulder on the opposite side. This mounting, although not new, gives large space for the differential as well as economy in bronze.

The differential originally chosen was of a well-known locking type, but because of the comparatively small number in use for this capacity a common type was substituted. This question has since been reopened, and at present the War Department is considering three possibilities—the common type, the locking type or no differential at all. The locking differentials on the samples so far have given complete satisfaction and seem to be adequate from the standpoint both of strength and wear. It is, however, a proprietary article, thereby conflicting with the Government's policy.

The differential worm and gear are mounted on a carrier piloted at the top of the housing. The gear adjustment is made by slotted and threaded rings in back of the bearing caps. The cups are clamped to the main pedestals by caps, nickel steel studs 1-in. diameter being used. The whole unit can be removed from the housing without disturbing any adjustments.

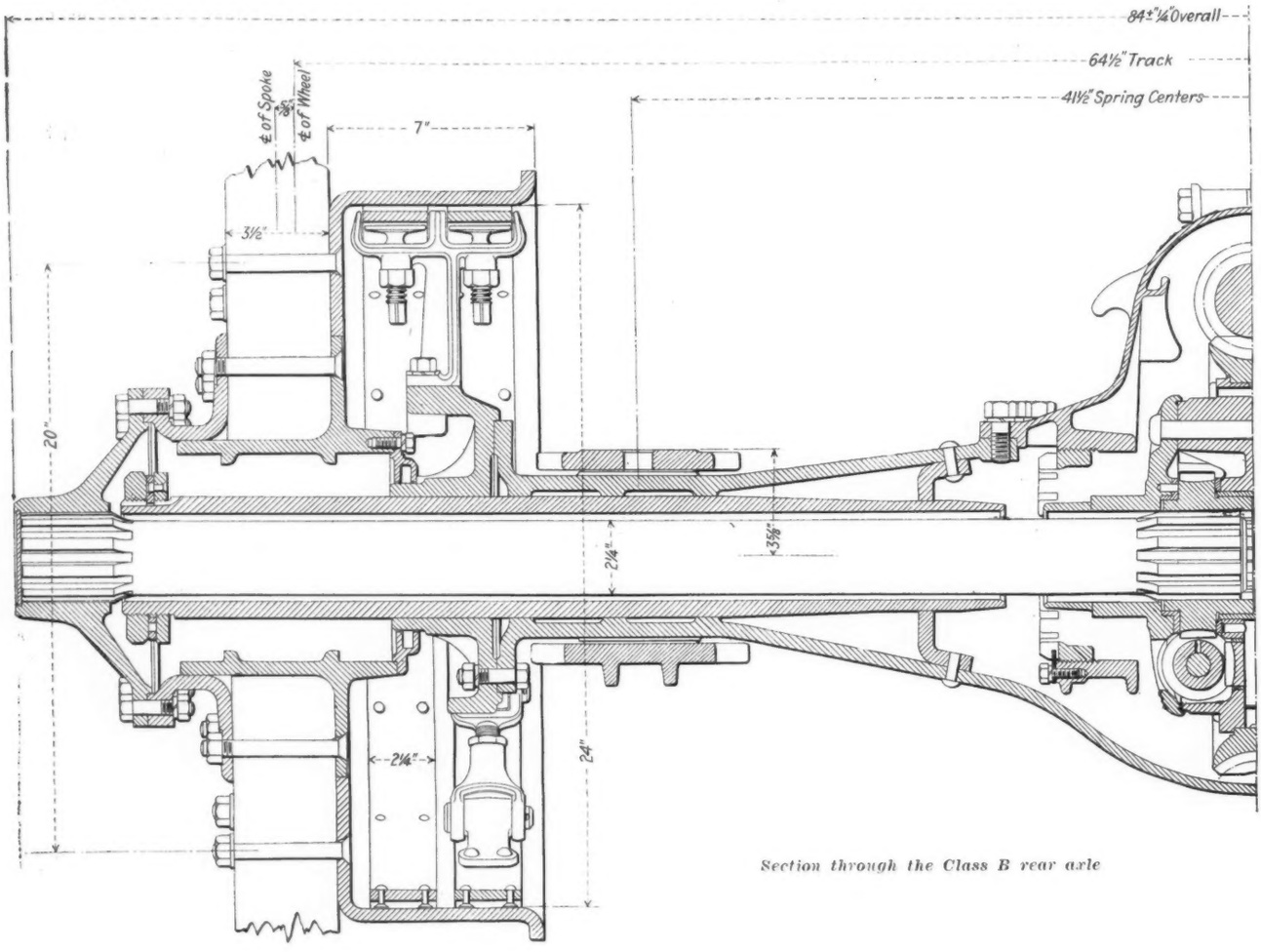
Throughout the axle the various parts have, wherever possible, been so designed as to permit assembling and dissembling as the following units: First, the shaft and drive-



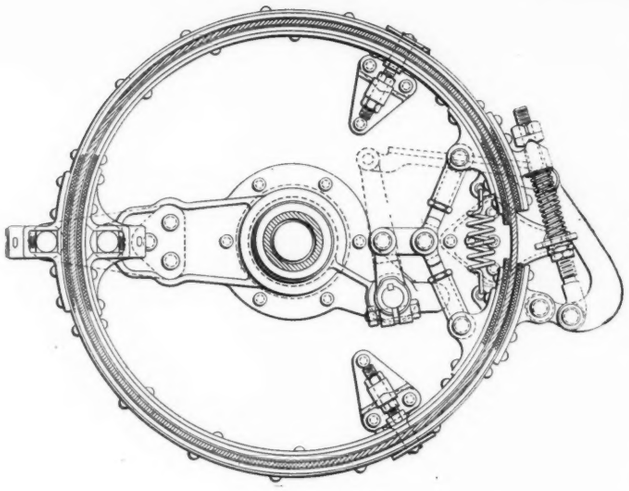
Section through worm gear

plates; second, the wheel, drum, bearings and dust washer; third, the brake anchor and bands, levers, shafts, and fourth, carrier and parts.

The brakes are side by side and are made of rolled stock, toggle operated, 24-in. diameter and 2 1/9-in. wide. The proper place for brakes is unquestionably on the rear wheels, provided they can be made of a size large enough to be



Section through the Class B rear axle



Brake assembly

dependable. Since the War Department permitted a 24-in. diameter the problem was merely one of designing a brake easy of adjustment and of dissembling or relining. The toggle brake in this instance was given preference because it made accurate forming of bands and machining unnecessary. The objection raised on account of the rattle is a secondary item when the braking power available is considered.

Besides the anchor and supporting pin (which is square) three additional adjusting screws are provided for each band, designed so as to make adjustments possible without removing the wheel and drum. These have mushroom heads to prevent pounding into the softer metal of the band. The drums are pressed steel, flanged to give rigidity. S. A. E. materials and standards are used throughout.

All bearings are tapered roller except the internal gear spur pinion and the wheel bearings on the Class A truck, which are of straight roller type. The manufacturers making the internal gear axles recommend this practice on the ground that failure to adjust would cause a misalignment of the gears.

Oilers and grease cups have been omitted wherever possible and pipe plugs substituted. All nuts of large diameter and fine threads are case hardened.

Class A Rear Axle

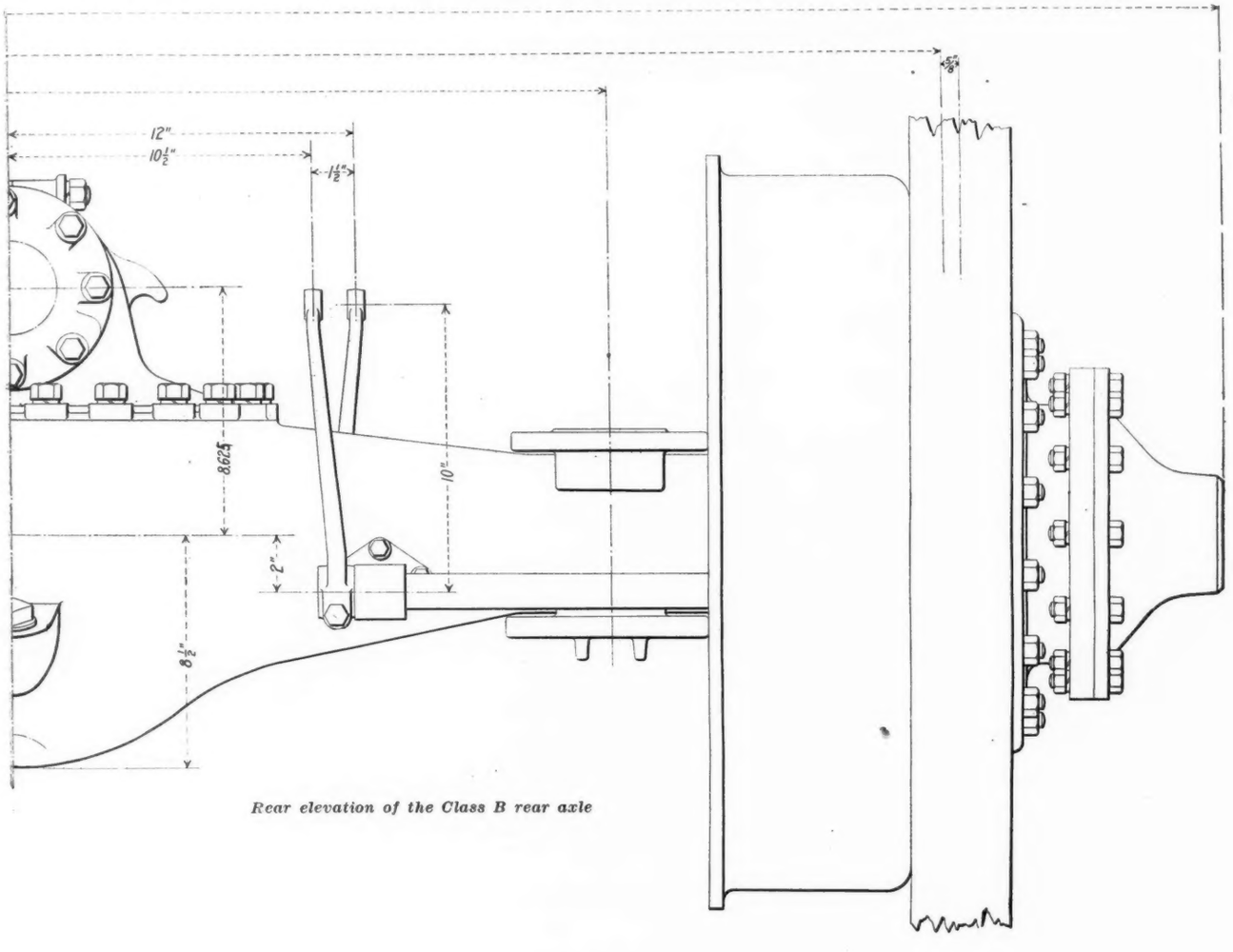
The internal-gear type axle was selected for the Class A rear axle; first, because of the available manufacturing facilities, and second, because of the high ground clearance desired.

The countershaft was located in the rear of the load carrying member; first, it made possible a simple assembling job; second, gear adjustment can be made by simply removing the rear cover plate (as in current passenger practice), and, third, the lighter weight thus secured.

The question the load added to the wheel bearings with this construction was considered, but these were found to be negligible as contrasted to those due to the road shocks.

The load-carrying member is a pressed-steel housing. The

(*Continued on page* 182)



Rear elevation of the Class B rear axle

Technical Analysis of Salon Bodies

Strong and Weak Points in Custom Work Foreshadow Coming Practice in Stock Design

By George J. Mercer

THE SALON plainly indicates that the body business still moves with its accustomed and well ordered regularity. There is a limit to the startling new things that can be created each year; something new must be pioneer work; as a rule they are raw in detail, and it takes time to mellow them, and this process of mellowing or refining is the test of their fitness to survive.

The present salon might be classed as conservatively new. There were some distinct innovations shown; some were good and others did not compare so well from a design standpoint.

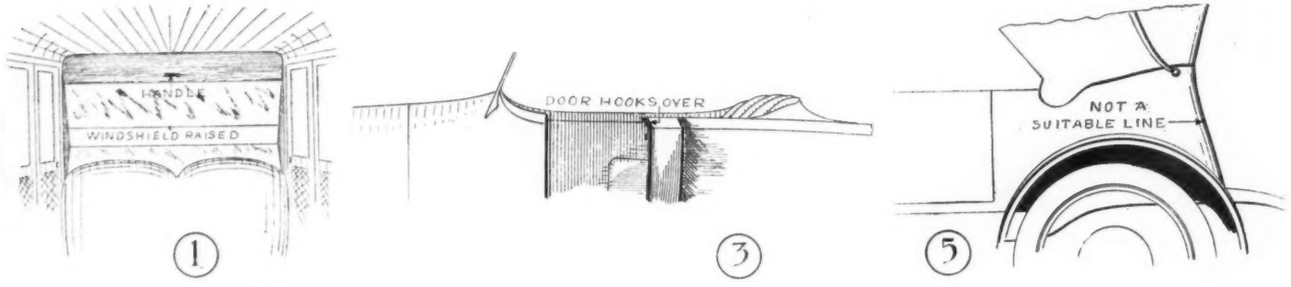
The Brewster inside drive, of which three photographic views are shown, is by far the best example of something new in design. The angularity of design is odd rather than beautiful, but as a complete body design it is a success. It is extremely light looking, which is what the public wants. It actually is about two-thirds the weight of the average body of the same class. It is an all season car; the roof, back and side quarters are of canvas and the interior finish of the doors and lower body are of canework. The seats are trimmed in canvas cloth, matching in color the cloth of the roof and back, and they are trimmed luxuriously thick. There is a canvas storm visor, and the windshield is operated by a patent device by which the glass moves upward in the slanting front pillars, operated by a handle on the inside, as illustrated on Fig. 1.

It is a four-door body, the doors being extremely light, and the glass frames are operated by straps. It has a sanitary interior look, the finish being in natural wood, the arm rests being of the same. The roof and back are khaki color, the body navy gray and red wheels, the extra wheel being carried at the rear.

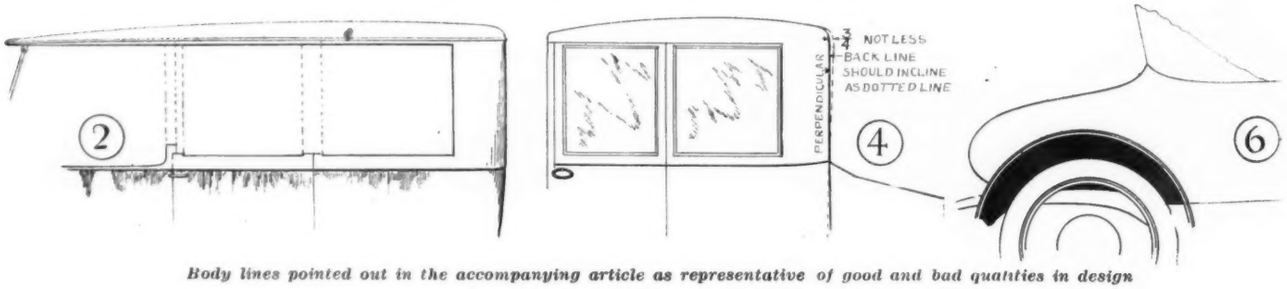
Fig. 2 is a sectional view of a Healey body on a Simplex. This is a clever innovation of the convertible idea. The dotted lines show the pillars in position and the body closed, and the full lines show it when open for summer use.

The cubist Murray was well made and represented an arduous and well-thought-out plan to make all parts harmonious; the top of blue leather blended nicely with the trimming and the aluminum finish. On closed bodies the cubist line is not so successful, which shows that this design is one that cannot be applied indiscriminately. It has the effect of making the roof line heavy looking, while at the rear corner a small bevel might be used by careful manipulation, but a bevel with a surface of six inches is not only expensive to construct, but conclusively is not a line of beauty. Possibly the beveled top body edge, which is so common on touring bodies, is in this class, although it is not so called, unless it has the deep bevel as shown on Fig. 3. This illustration shows the objection of the extreme bevel; the top hooks over and interferes with the entrance; also this wide bevel has the look of being crooked, as it follows the curve of the body from front to rear.

The White collapsible body has the doors opposite the front seat and entrance to rear seat is by passage between. This is a close coupled body, with the rear part collapsible from the back of the door.



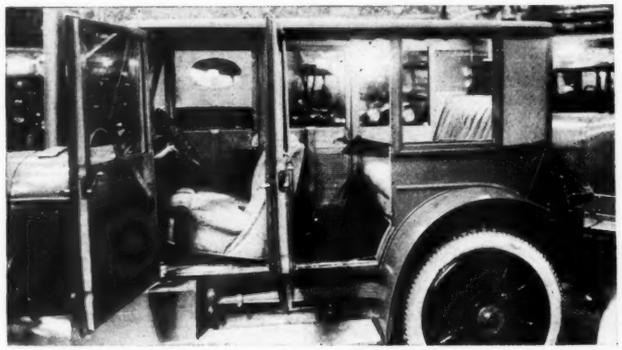
Illustrating body features on some of the Salon constructions of unusual character



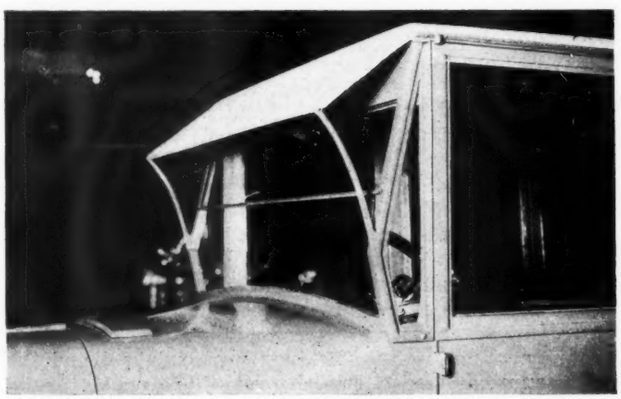
Body lines pointed out in the accompanying article as representative of good and bad qualities in design

There were two cases that either by accident or mistake violated a fundamental rule in bodymaking. The back line of a closed body, as illustrated on Fig. 4, should never be perpendicular. It is an optical illusion that when this line is straight up and down it appears to lean forward, and should be set back just enough to overcome this; about three-quarters of an inch will make this look right for the average body. Sometimes, if the chassis is higher at the rear than usual, this will have to be increased. The other case was an error of having too much slant in the opposite direction. This rule is so old that it seems strange that errors of this kind would be made.

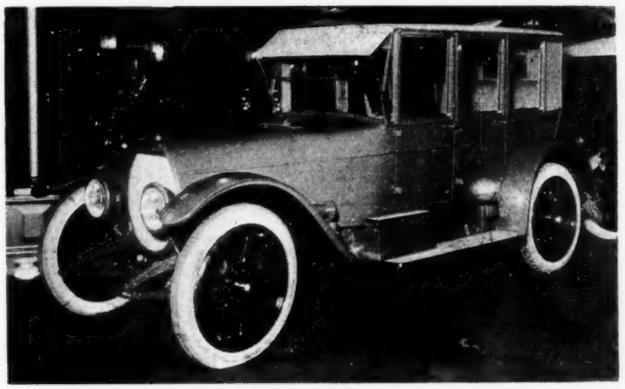
Other criticisms are Figs. 5 and 6. In the first the line is never suitable for the ending of a touring body. Particularly will this line look bad when the top is up. And Fig. 6 is a line that is frequently used, but so seldom satisfactorily that most designers leave it severely alone. Another criticism was that some cars had the guards too wide. This is a fault that is seldom met; usually the fault is in the opposite direction. The second cowl was an offender also, by being too high above the body side, and also too wide. The second cowl has been the medium by which the top of the driving seat has been made less objectionable to the view, but when the cowl is wide from back to front, as well as being high, it simply looks like a mountain in the middle of the body and is more objectionable than the older form of seat back. One cowl on a car exhibited was high, but it was narrow and was relieved by a natural wood finish, and looked fairly well. The narrow second cowl is no doubt the best solution to date for minimizing the driving seat top, but to get the best results it must not come unduly above the body side.



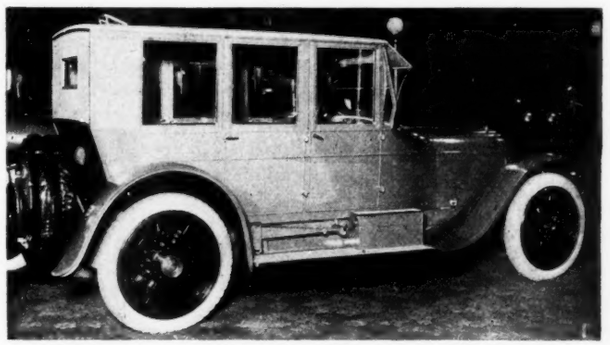
The Brewster sedan was characterized by square military lines



Rear view of sedan showing the utilization of khaki colored canvas



Brewster inclosed drive sedan finished in cane and natural wood

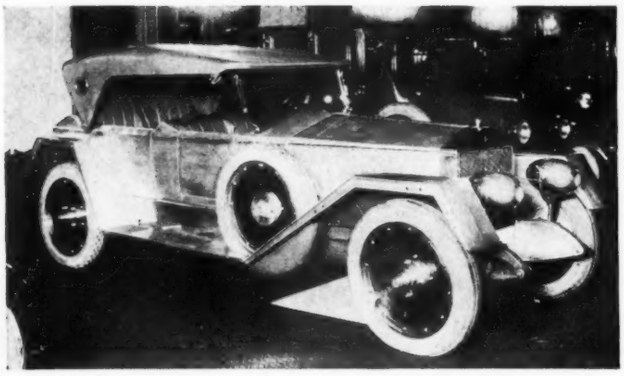


Windshield and peak on the Brewster inclosed drive model

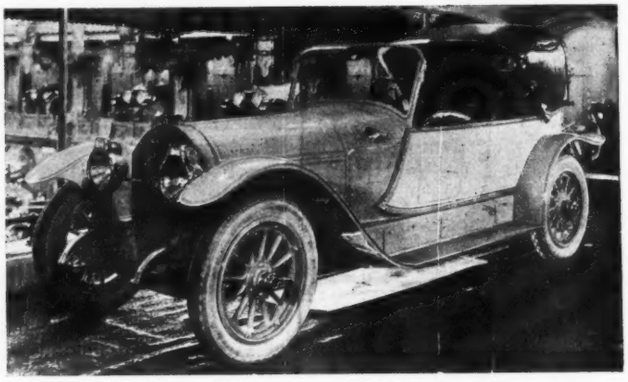
The finish of the top of the body side on open bodies was not as sharply defined as at the Palace show, in fact it is necessary to take a summary of both, in order to arrive at a valuation as to the best outlook for the coming season. At the Salon, there were the rounded top, the bevel edge of moderate slant and the flat top with a molding finish. Briefly, it looks as if the bevel edge with the blended small second cowl will be the standard for stock cars and for the custom bodies, the same thing with a fair sprinkling of flat top with molding finish and the driving seat back very low but independent of the body side.

Body Edge Lines

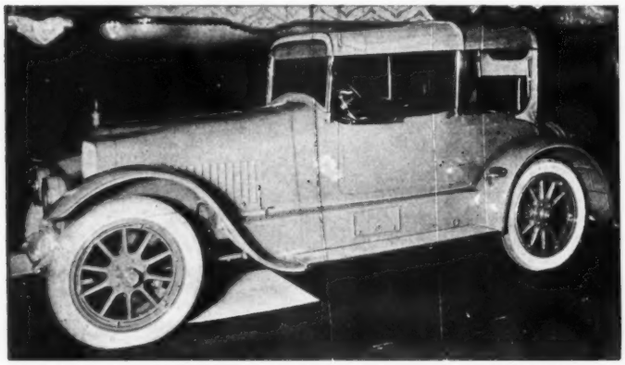
The desire to keep the body side low as it reaches the back line has made the use of the gypsy quarter to the top more popular, and the Victoria top is being used in greater numbers. There is a marked tendency to close more of the rear of the body in with the top than formerly. There were few ventilators in the sides of the body, but nearly all had the ventilator in the top of the cowl. Many of these seemed to be thicker looking than necessary and stood up too far above the cowl. Square doors at the bottom were the rule on all bodies and most were flush with the body panels; very few used door moldings. Straight door handles were common on all bodies, and the touring bodies had for the most part either the regulation outside handles or handles set at the top and visible. The slanting windshield is used almost exclusively. The guards were more of the plain convex shape. Town cars used the six guards with a step, and some touring cars had cycle guards and steps, but they were not numerous. The Rolls-Royce guard is a very attractive and graceful design. It is expensive to make and therefore confined to high grade custom work. Most of the cars at this show carry the extra



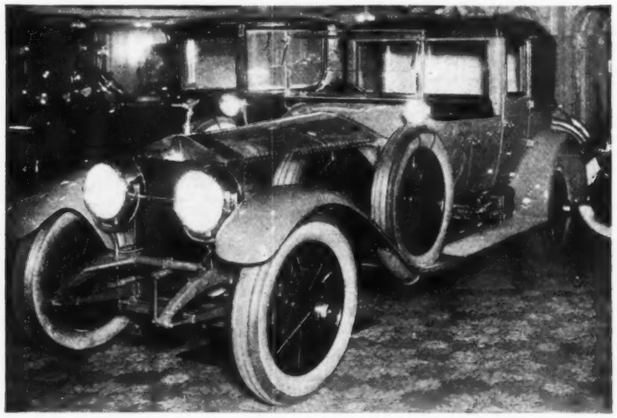
Murray roadster with cubist lines carried throughout



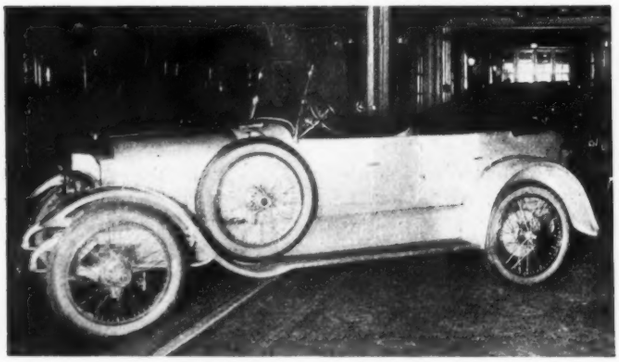
Rubay body on a four-passenger Locomobile in French gray



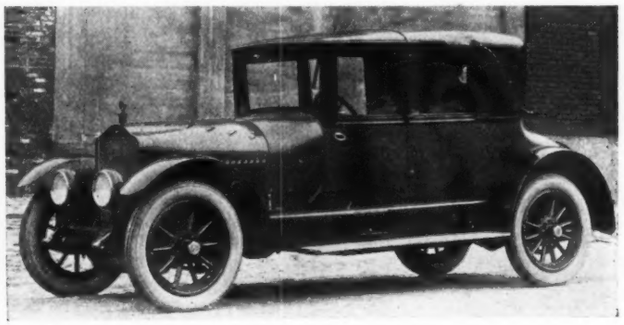
A Rubay body on a White roadster with disappearing top



Rolls-Royce chassis fitted with up-to-date example of collapsible body construction



Biddle touring car which carries out the long sweeping lines and low-hung characteristics



White cabriolet with an example of Rubay body work. This is in a special gray color

wheels at the side forward of the runboard. Wire wheels were very much used and some used the disk covering the spokes. There were also many cars with the long, narrow louvres of the Rolls-Royce pattern.

Errors in Lines

Some few of the closed bodies erred in having the thick looking roof and the high looking body. All, however, had the moderate straight roof line. There were more closed bodies, however, that had the desired low look and light appearance. There were the usual number of enclosed drive bodies with the slanting front, and there was only one with the V front shield. This latter did not hold its own with last year, an evidence that it has not gained much in popular favor. The town car bodies were exceptionally good, both the broughams and the cabriolets being well designed and finely finished, and there was evidence that the falling top body is again coming back into favor in other designs besides the cabriolet, which has always had its place well assured as an exclusive town body.

The keynote of the trimming design and appointment this year seemed to be simplicity in colors, appointments and design, and yet the desired luxuriousness was retained. The plain pleat was the most common, but there were several that were severely plain, the cushion and back having in addition down-filled pillows. There were also plain designs that were relieved with cords crossing at right angles, the intersections being caught by square buttons and forming panels about 12-in. square.

The materials used were broadcloths of light shades, narrow cords and again narrow stripes of French bedford. In all cases the markings were subdued and the colors approximated a French gray. The appointments were of the usual character; the vanity cases had silver appointments and the case itself being natural wood.

Tractor Radiators, Their Calculation and Design

Considerations of Proportion of Heat Input Compared with Jacket Losses—Influence of Radiator, Pump and Fan

By Arthur B. Modine*

I HAVE often been asked to give some general formula for the determination of radiator sizes, but there are so many factors other than that of radiator size involved, in tractor engine cooling, that up to this time I have avoided the subject. The variables are principally those of radiator type, radiator core thickness or degree of cooling capacity, rate of water ciculation, size, type, and speed of fans, and the economy characteristics of the engine to be cooled. I do not believe it practical to evolve a formula covering all the branches of gas engine operation, but believing the time opportune for a certain degree of standardization of the variables referred to I am taking advantage of this opportunity to go into some of the essentials of tractor engine cooling.

The study of gas engine cooling brings into consideration a diversity of elements in engine design, all affecting the economy of the engine, and ultimately for our purpose that proportion of heat input showing up as jacket loss. Equation No. 1 is our introductory and basic formula, in which

Equation No. 1

$$\textit{Heat to radiator} = \begin{cases} \textit{Heat input—horsepower developed} \\ \textit{Exhaust loss—engine radiation and} \\ \textit{Convection losses.} \end{cases}$$

All the factors of this equation for any given engine are computable, but for general use certain assumptions are required together with the introduction of a variable factor.

Equation No. 2

$$\textit{Heat to radiator} = .40\ \textit{heat input} \times F.$$

where F is a variable value of 1 in the case of L-head engines from 25 to 50 hp. and .8 in the case of valve-in-head engines of the same power range as based on observed average performances. Individual peculiarities of jacket design, piston speed, compression, proportion of engine radiation and convection loss, valve design, etc., would all, of course, further affect the value of the factor, but I believe that the formula as suggested will be found sufficiently accurate for our purpose.

Taking average tractor engine economy as .75 lb. of gasoline per horsepower per hour, and a heat value per pound of gasoline of 20,000 Btu; we find that Equation 2, applied to the L-head type engine, becomes

Equation No. 3

$$\textit{Heat to radiator per min. per hp.} = \frac{.40 \times .75 \times 20{,}000}{60} \times 1 =$$

100 Btu.

so if we are to cool a 30 hp. L-head engine under full load, it is necessary to provide cooling capacity equivalent to $30 \times 100 = 3000$ Btu per minute.

It may be interesting to note at this point the manner in which this quantity of heat would manifest itself were no other means available to dissipate it other than the evaporation of water. Three thousand Btu per minute would evaporate approximately 3 lb. of water per minute, 180 lb. per hour, or about 21½ gal. per hour. Double this to 43 gal. per hour for, say a 60 hp. load and we get an idea of the difficulties the pioneers in the tractor industry were up against in getting a sufficient supply of tank materials. Aside from other considerations, it is manifestly impractical to carry around a great bulk of water such as would be required; and to meet these conditions, it has been found necessary to transfer this waste heat to the surrounding atmosphere through the medium of the conventional radiator and cooling system.

This comprises a radiator, generally a circulating pump, and a fan, the radiator consisting for the purpose of our discussion of a multiplicity of tubes conveying the water to be cooled and spaces around these tubes for the passage of air. Referring to Fig. 2 consider the factors involved in the transfer of heat from the engine, through the radiator and into the atmosphere. The water from the engine is delivered to the radiator at a temperature T_1 and must be cooled to a lower temperature T_2. The heat then taken from the engine or from the water will be in terms of the weight of water circulated (W_w) times the temperature drop ($T_1 - T_2$) effected upon it by its passage through the radiator and may be expressed as $W_w\ (T_1 - T_2)$.

It is evident that the heat removed from the water must (under normal operating conditions) equal the heat imparted to the air and will be measured in terms of the weight of air circulated (W_a) times the temperature rise ($T_4 - T_3$) effected upon it by its passage through the radiator or $W_a\ (T_4 - T_3)$.

From this balance we get our Equation No. 5

Equation No. 5

$$W_w\ (T_1 - T_2) = W_a\ (T_4 - T_3)$$

which expressed in foot pound second units becomes, in Equation No. 6,

Equation No. 6

$$W_w\ (T_1 - T_2) = V_a \times .071 \times .2375\ (T_4 - T_3) = .01685\ V_a\ (T_4 - T_3)$$

in which W_w is weight of water in pounds, V_a is the volume of air in cubic feet, .071 is the weight of 1 cu. ft. of air at 100 deg. temperature Fahrenheit, and .2375 is the specific heat value of air.

Equating this last relation with Equation No. 3 we get

Equation No. 7

$$\textit{Heat to radiator per minute per horsepower} = 100\ B.t.u. = W_w\ (T_1 - T_2) = .01685\ V_a\ (T_4 - T_3)$$

and from which we derive

Equation No. 8

$$W_w\ (\textit{or pounds water})\ \textit{per minute per horsepower} = \frac{100}{T_1 - T_2}$$

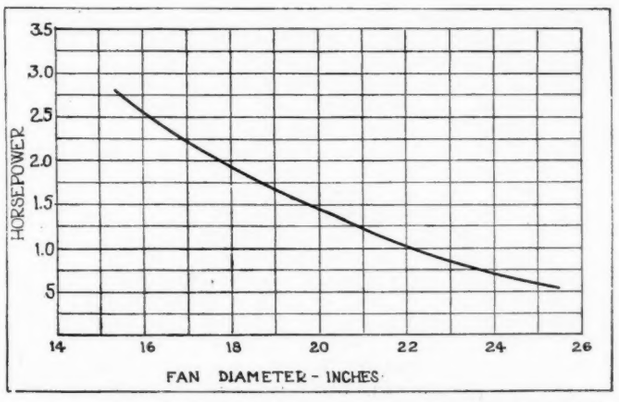


Fig. 1—Power absorbed by different fans delivering 7000 c.f.m. air

*Read before Minneapolis Section, S. A. E.

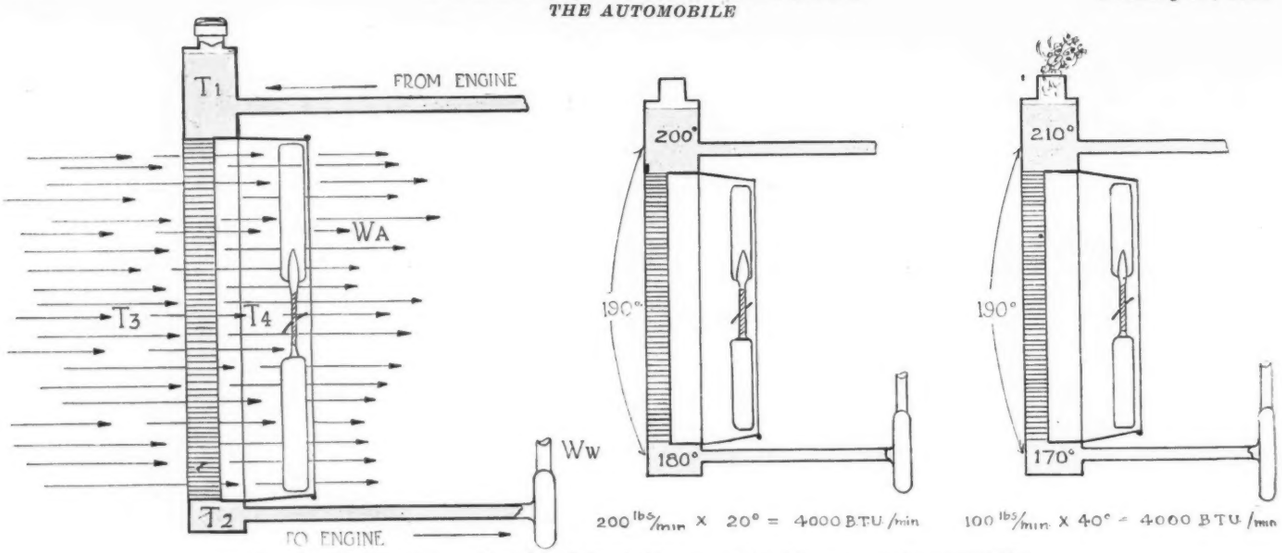


Fig. 2—Diagram illustrating the effect of the rate of circulation on cooling capacities

Equation No. 9

$$V_a \text{ (or cubic feet of air) per minute per horsepower} = \frac{100}{.01685\, V_a\, (T_4 - T_3)} = \frac{6000}{T_4 - T_3}$$

and from Equation No. 9, inasmuch as volume of air is a function of velocity and area, we get

Equation No. 10

$$\text{Square feet frontal area radiator per horsepower} = \frac{6000}{(T_4 - T_3)\ f.p.m.}$$

These values are all dependent upon the value of the factor *F* in Equation No. 2. This factor has been omitted to avoid the use of too many symbols, but in view of its value of 1 for L-head types, the formulæ will apply directly as they are to this type, while for the valve-in-head classification they are to be multiplied by the factor with value .8 as designated.

From an analysis of Equation No. 10 we see that our problem of cooling or of radiator size has resolved itself into a consideration of two factors, temperature rise effected upon the air and the velocity of the air.

The first factor, temperature rise of the air, I have made the object of considerable investigation and research work which is considered well repaid by the satisfaction that it will result in the conservation during this year of several million pounds of copper that would otherwise have entered into the construction of radiators. The subject is most important to our discussion.

1—To water delivery.

2—Its relation to air velocity.

We have a physical law which states that the amount of heat given off from a source is proportional to the difference in temperature between the radiating body and the air, and we have other authority which states that the loss of heat by convection is nearly proportional to the difference in temperature between the hot body and the air. This being true, we are concerned in maintaining the surfaces in a radiator at as high an average temperature as is practical, and this, of course, in our case is directly a function of the rate of water circulation. It becomes a matter, then, of choosing a standard for circulation that will give practical pump sizes and still maintain a reasonably small temperature drop through the radiator. With this in view, I propose as a standard that rate of circulation that will give a temperature drop to the water circulated through the radiator of not more than 15 deg. From Equation No. 8, then, we get

Equation No. 12

$$\text{Pounds water circulated per minute per horsepower} = \frac{100}{15} = 6.67$$

$$\text{Gallons water circulated per minute per horsepower} = .8$$

This would give a circulation per minute of 16 gal. for a 20-hp. engine, 24 gal. for 30 hp., 32 gal. for 40 hp., and 40 gal. for 50 hp.

The diagram, herewith, illustrates the effect rate of circulation has on cooling capacity. In the first radiator, water enters at a temperature of 200 deg. and is circulated at the rate of 200 lb., about 24 gal. a minute, leaving the radiator at a temperature of 180 deg. The heat given up amounts to 4000 B.t.u. per minute, and the average temperature of the radiator surfaces is 190 deg.

In the second case conditions are the same, except the circulation in this case is only 100 lb. per minute, requiring a 40-deg. drop to get rid of the same amount of heat as in the first case. The fan is not drawing any more air, consequently, in order to absorb the same amount of heat as in the first case, the average temperature of the surfaces must be maintained at 190 deg. and which requires a water temperature entering of 210 deg. and leaving of 170 deg.—or all the difference with the same radiator between satisfactory cooling on the one hand and boiling on the other.

The relation of temperature rise of the air to that of velocity of the air over the heated surfaces will have to be treated briefly with the statement that as we get up into the velocities practical for our purpose that the heat taken up by convection increases nearly directly in proportion to the velocity. This is illustrated by the temperature rise curve shown in Fig. 3, which is typical of the temperature rise characteristics of almost any type of radiator, as well as the thickness of radiator core. The only limit that we are bound by in air velocities is the power available to effect the velocity, but with this in view, as well as my further remarks on this subject to follow, I would propose a standardized air velocity referred to gross radiator core area of 2000 f.p.m.

This velocity is practical with most of the radiator types on the market and as applied will meet nearly all requirements up to 50 hp. in space available for radiator mounting. The matter of a definite value for the factor $(T_4 - T_3)$ is one which is concerned with the characteristics of design of each type of make of radiator core and its thickness, but most of them intelligently offered for tractor work will be able to meet the requirements of a 30-deg. rise with initial, or operating, temperature of 100 deg., air velocity 2000 f.p.m., maximum water temperature of 200 deg. and water circulation as suggested. With these assumptions meeting with your approval, Equation No. 10 reduces to

$$\text{Square feet radiator required per horsepower} = \frac{6000}{30 \times 2000} \times 1 = .1\ L.H.$$

$$\text{Square feet radiator required per horsepower} = \frac{6000}{30 \times 2000} \times .8 = .8\ V.\text{-}in\text{-}H.$$

From some fifty cases that I am familiar with, I have tabulated data as to rated horsepower (using the formula $\frac{D^2 SN}{F} \times$ No. cyls.), in which F has a value of 12,000 for V-in-head and 13,000 for L-head types, actual radiator size, fan size, and fan speed in each instance. These cases I have divided into groups of increasing horsepowers and averaged the data in each group.

In applying the suggested formulæ for radiator size I find that it would check well in the 20-hp. group if a few of the cases would run their 18-in. fans at a higher speed than 1450 r.p.m. In the 30-hp. division L-head type actual radiator size shows about 12 per cent larger than that proposed by the formula, but the average fan of 19 in. diameter was driven at only an average speed of 1600 r.p.m. In the 30-hp. valve-in-head class the formula radiator size shows about 3 per cent larger than actual sizes with average fan size 18.66 in. and average fan speed 1866 r.p.m.

In the 35-hp. L-head class the formula radiator size shows about 3 per cent larger than actual size. Average fan size is 19.3 in. and average fan speed 1666 r.p.m. Some of the cases in this division I know are not cooling properly, and the division as a whole could well afford to go to larger fan diameters.

In the 40-hp. class the formula radiator size checked with the actual size.

One 50-hp. case, a well-known tractor, gives formula radiator size about 13 per cent larger than actual size. This tractor, however, is considerably overpowered, but its cooling performance in average conditions is entirely satisfactory. I know, and its makers know, however, that at heavy full load boiling will occur, and they feel as I do that the 13 per cent additional as recommended is justified.

One 64-hp. valve-in-head tested a short time ago has actual radiator size about 4 per cent greater than formula size, but the cooling capacity was found to be at least that amount in excess of requirements. As we get up into higher horsepowers the space available to mount the radiator in becomes more and more an important factor, so that it becomes necessary to increase air velocities and fan speeds at the expense of added power for fan drive. This introduces an added variable in our formulæ and consequently the radiator size formulæ are not recommended for use above 50 hp. The basic equations may, however, be adapted to the larger powers.

We have seen by the foregoing that our problem of cooling is fundamentally one of how much air we can economically deliver through the radiator and to what degree we can economically heat it. Granted that we have efficient fans to choose from, it would seem that our first consideration should be the amount of power that we would be justified in using to effect the delivery. Also it would seem that this available power could properly be expressed in terms of engine horsepower.

In Diagram 4 is shown air deliveries effected by a typical 20-in. fan at varying fan speeds, corresponding air velocities and power consumption, the characteristics of each of which are typical of fans such as offered to the trade. It will be noted that the volume of air that can be handled and its corresponding velocity increases well in proportion as the speed increases, but as we consider the power consumption curve it is evident that a certain point is reached in fan speed beyond which the power consumption mounts upward with astounding rapidity.

If it were not for this we could deliver so much air through the radiator that there would not be much left for the radiator manufacturer to do, as the radiator cost curve indicates, but in this event, of course, the purpose of the tractor engine would be subverted to pulling wind instead of plows. On the other hand, the fan speed could be so low that the radiator cost would be abnormally high, and so our problem becomes also one of where to content ourselves along the power consumption line.

Consider for the moment a 35-hp. L-head engine. We find from Equation No. 9, and using our standards, that volume of air for cooling required per minute is equal to $35 \times \frac{6000}{30} =$ 7000 cu. ft. Going to our volume curve in Fig. 14, we find that in order to effect this delivery we would require a 20-in. fan to be driven at 1775 r.p.m. The power required would be about 1.5 hp. and the resulting velocity very nearly checks with our suggested standard of 2000 f.p.m., giving a radiator size of 3.5 × 1 or 3.5 sq. ft. The percentage of power for fan drive would, in this case, amount to about 4½ per cent of the engine power, and in checking over the other groups in our power range experience I find that this 4½ per cent is about typical of prevailing practice.

Suppose, however, that we had chosen a 22-in. fan for our purpose in place of the 20-in. fan. From Fig. 1, showing power consumption of different size fans, each delivering about 7000 c.f.m. air through a radiator, we find that whereas it requires 1.5 hp. to deliver the 7000 cu. ft. air with a 20-in. fan at 1775 r.p.m., that it would require only about 1 hp. for a 22-in. fan to deliver the same volume at 1400 r.p.m.

If the fan and the radiator were properly incorporated in the tractor design from the beginning instead of being thrown on somehow or other at the last minute, you would be able to save .5 hp. or .375 lb. of fuel for each hour of engine operation. If the tractor is operated 1000 hours per year, the saving, with fuel at 20 cents per gallon, would amount to $12 per year, and assuming that this saving could be applied to only 100,000 tractors, we get a figure that is certainly worth while making an effort to conserve.

In my recommendations to follow for fan sizes, therefore, I have in mind larger fans and slower speeds than what is now average practice, and propose the power consumption for air deliveries should not be more than 3 per cent of formula rated engine power. Although this is a subject that could be dealt with more intelligently by the fan manufacturer, I believe that the following table showing recommended

(*Continued on page* 199)

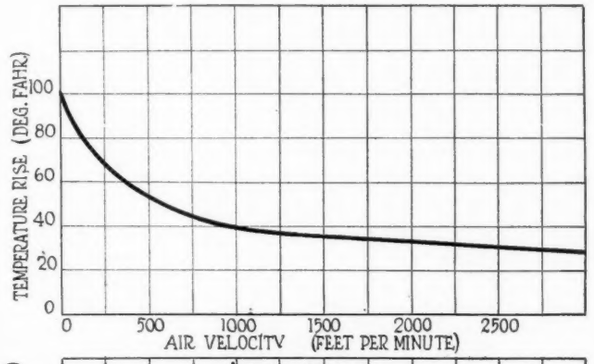


Fig. 3—Temperature rise curve typical of any radiator

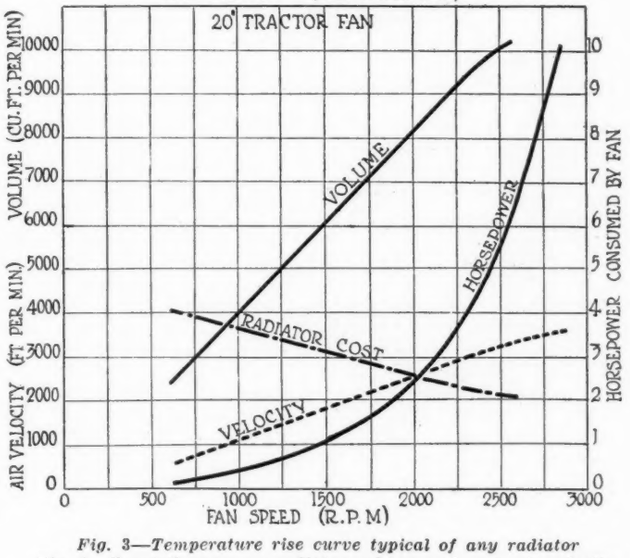
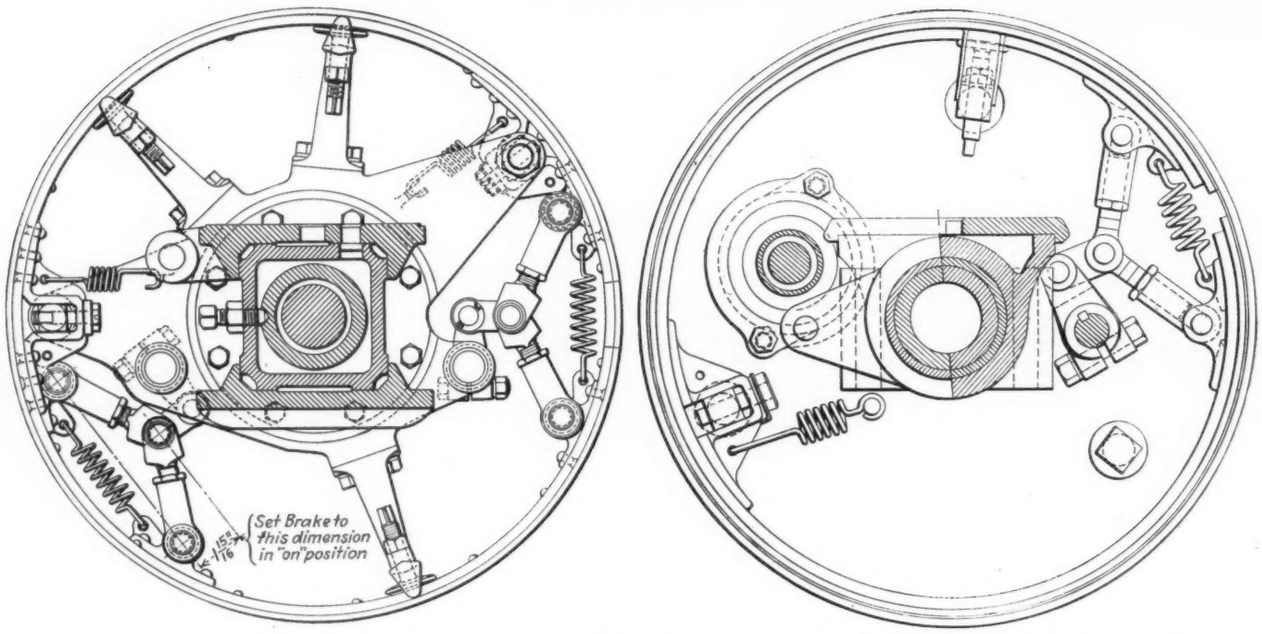


Fig. 4—Fan influences on radiator volume and cost, air velocity and horsepower consumed



Two sections through the rear axle showing the form of the tube at the spring seat and inside brake drum

Design of Military Truck Axle

(*Continued from page* 175)

differential carrier is bolted to the inner face of the front flange. The drive-shaft tubes are ⅛-in. wall tubing, flanged at the inner end and bolted to the aluminum case, and piloted into a felt ring at the outer end.

The bevel gears are somewhat larger than necessary owing to the fact that provision had to be made for a locking differential. The wheel brake (emergency) is of the toggle type, the service brake being attached to the transmission.

Class AA Rear Axle

The Class AA rear axle is of the generally accepted full-floating passenger-car type, selected because of the large production possible. The ring gear is 12⅞-in. diameter, 61-teeth pinion, and 11-teeth, 4¾-in. pitch spiral-bevel gear. Current practice has been followed in each feature.

Magnesium

WHEN the European war started, practically all of the magnesium used in this country came from Germany. It soon, however, practically disappeared from the market here and the price soared to a prohibitive figure, so that many manufacturing concerns discontinued its use. It is now being made in this country in comparatively large quantities and the price has been reduced and is approaching that which was general before the war.

One of the principal uses of magnesium is for alloying with aluminum for airplane parts, where lightness is important. By the proper combination of magnesium, aluminum and other metals, in small quantities, an alloy can be produced which will reduce the weight to nearly one half below that of No. 12 aluminum, it is said. This is probably on the basis of strength and not of bulk.

Magnesium is being used more and more as a deoxidizer and scavenger for copper, brass and bronzes, and a new alloy of magnesium has been prepared for use as a deoxidizer and scavenger for high grade tool and alloy steels.

Another large use of magnesium is in the powdered form for light bombs and flares for lighting night attacks on the the European battle fields.

A new company, named The American Magnesium Corporation, was formed for the manufacture of magnesium and magnesium alloys in January, 1917, with a plant at Niagara Falls, N. Y. and is now, probably, the largest producer in the United States.

Barrett Multi-Trucks

A SPECIAL system of material transport in factories has been worked out by the Barrett-Cravens Co., Chicago, Ill. Use is made of so-called multi-trucks in connection with platforms on which the material is piled. The platforms are constructed of wood. These platforms stand from 6½ to 10½ in. above the floor, thus allowing the truck to be pushed under them. The advantage of this is that the truck need not be idle while being loaded and unloaded, and a much smaller number of trucks will serve in a factory than would otherwise be the case. The man handling the trucks does not handle the material. He simply picks up the platform upon which the goods are piled, moves it and sets it down again. These trucks are said to have proven of particular advantage in large automobile plants.

By a downward sweep of the handle the load is lifted off the floor a distance of 1½ to 2½ in., depending upon the size of truck. When thus raised the truck is latched automatically. The wheels being mounted on roller bearings, the truck rolls easily. It is a four-wheeled truck, the advantage being claimed over a three-wheeled construction that it cannot stick in ruts or bind on the floor at turns. The fore-carriage can be swung through an angle of 300 deg., hence very short turns can be made. At the destination the load is released by pressing with the foot on a release latch and an hydraulic release check lowers the platform gently to the floor. The truck handle does not drop to the floor but remains at such a height that the truck man can pick it up without stooping.

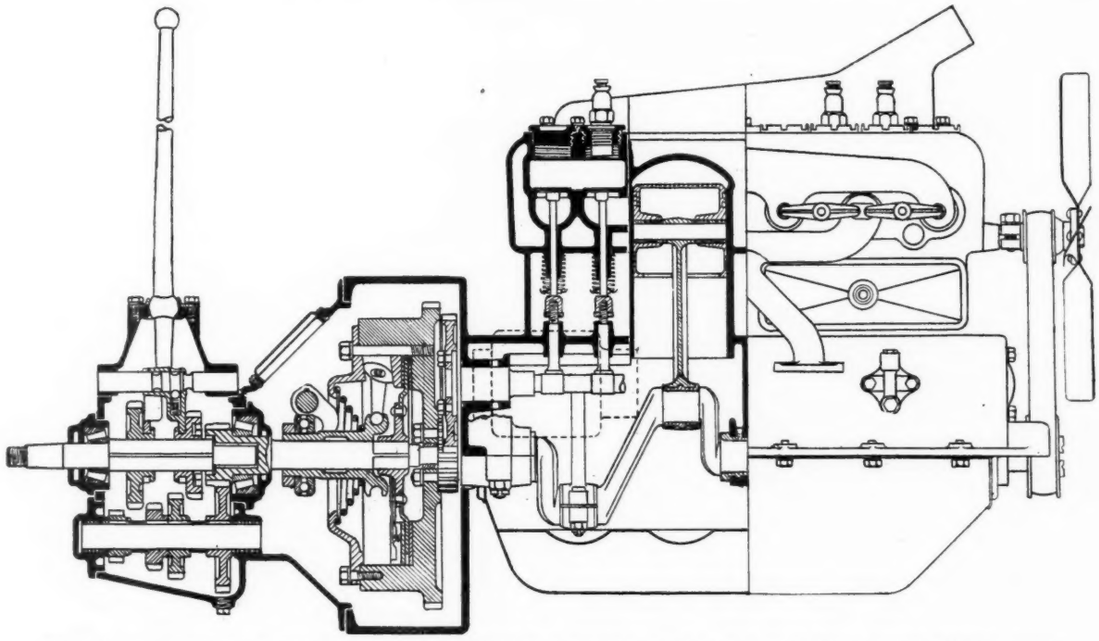
Book Review

THE MODERN GASOLINE AUTOMOBILE, ITS CONSTRUCTION, OPERATION, MAINTENANCE AND DESIGN. By Victor W. Pagé, M.E. 1918 edition. Published by the Norman W. Henley Publishing Co., New York. Price, $3.

THE 1918 edition of this well-known book has been revised and has had matter pertaining to recent developments in automobile engineering added. Although the term automobile in its ordinary sense hardly covers the tractor, farm tractors of various types as well as so-called tractor attachments are dealt with at some length. Among the subjects which either are discussed for the first time in the 1918 edition or are dealt with at greater length than in previous editions are helical bevel gear drives, incorrectly called skew level gear drive. A large number of new illustrations have been added.

New Unit Power Plant for Light Trucks

THE A. B. R. Engineering Co., Stamford, Conn., has developed a unit power plant suitable for use on commercial cars of 1000 lb. to 1½ tons capacity. A sectional view of the unit is shown herewith. The engine is of 3¾-in. bore by 4-in. stroke and has its cylinders cast in a block integral with the top half of the crankcase. In the cut the cylinder head is shown integral with the cylinders, but if so desired by the customer the company will make it separate. Cylinders are of the L-head type and the valve springs are inclosed by pressed steel plates. The valves have cast-iron heads, and the tappets, which are of the mushroom type, are provided with adjusting caps and lock nuts. The crankshaft is supported in three main bearings. Crankshaft and connecting rods are drop forgings of high carbon steel and are suitably heat treated. The piston pins have their bearings in the piston bosses, into which are inserted bronze bushings. The crankshaft main bearings and connecting rod head bearings are die cast of nickel babbitt. Two Wasson concentric, peened rings are fitted to each piston.



The A. B. R. power plant, comprising a Ford-size engine, disk clutch and three-speed sliding gear

A notable feature of the engine is that the cam gears are located at the rear end between the rear crankshaft bearing and the flywheel. This obviates the need for a separate housing for the gears and makes a better manufacturing job. The cam gear pinion is forged integral with the crankshaft and serves also as a flywheel flange. It will be noticed that the camshaft gear is bolted to an integral flange on the shaft, which makes a very substantial construction. Meshing with the camshaft gear at the side of the engine is a gear for driving the electric generator and ignition device. The flywheel is shown provided with a gear crown and provision is made for fitting an electric starter. The bottom half of the case is made of pressed steel, with oil pans under each of the connecting rod heads. Where the bottom half joins the top half, grooves are provided for the insertion of felt rings to insure an oil-tight joint with the bearing caps.

Oil is circulated by means of a plunger pump driven off the camshaft. This draws oil from the base and delivers it into a trough running along the side wall of the crank chamber above the camshaft bearings, from which feed holes extend to all of the bearings. All other interior parts of the engine are lubricated by splash. The engine is designed for thermostatic circulation of the cooling water. It is fitted with a four-blade fan driven by a one-inch flat belt from the forward end of the crankshaft. The hub of the fan is provided with two bronze bushings and an oil pocket.

A clutch of the three-plate type forms part of the power unit. The central member, which consists of a steel disk, is mounted on a hub fitted on a squared portion of the clutch shaft. Two rings of friction material are used, and these may be either of Raybestos or fiber. One of these rings bears against the web of the flywheel, and the other is secured to a disk driven from the flywheel through a number of bolts serving as keys. The disks are pressed together by means of three toggle levers with double cam surfaces, one of the cams bearing against the floating ring and the other against the interior surface of the rear clutch cover. The toggle levers are provided with oblong holes, through which extend pins secured in lugs cast on the rear clutch plate. The clutch is held in engagement by a volute spring and is disengaged by shipper levers bearing against a ball-thrust collar.

The transmission gives three forward speeds and one reverse. All shafts are made of 3½ per cent nickel steel and all gears of chrome-vanadium steel. The primary shaft of the transmission is supported in Bower roller bearings, while the secondary shaft is carried in plain bearings. A plain bearing is also used at the forward end of the squared shaft where it telescopes into the driving pinion shaft. The gear is operated selectively by means of a ball-supported, ball-ended lever.

It is the intention of the A. B. R. Co. to furnish this power plant complete with carbureter, ignition outfit and electric generator, as well as with gear lever and clutch pedal. This makes a complete power plant ready to be dropped into the frame of a commercial vehicle chassis. The company is well equipped to turn out these power plants in quantities and an annual production of 20,000 sets is figured on. The company's present works contain 42,000 sq. ft. of floor area and 38,000 sq. ft. is now being added.

AUTOMOTIVE INDUSTRIES
The Automobile

PUBLISHED WEEKLY

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The Liberty Engine

NO more suitable occasion could have been found for the unveiling of the Liberty engine than that of the meeting of the Society of Automotive Engineers in New York. Here were gathered together the men whose co-operation made possible the carrying out of the greatest task in the United States war program to date.

For weeks the public—as well as the engineering fraternity—have been eagerly waiting for some definite word as to whether the power plant which is to be the basis of America's air campaign is a success. It has been the greatest question in the minds of those who are impatiently waiting for progress toward the end of the war, and the answer was given on an occasion which may be truly set down as the most historic in the annals of the society.

With the auditorium and gallery of the most noted engineering gathering place in the country packed to capacity, three men who are responsible from the military, engineering and production standpoints respectively, laid bare the real facts in connection with the Liberty aviation engine. Then, after Col. V. C. Clark, Maj. J. G. Vincent and H. M. Crane had given the tactical, engineering and manufacturing reasons behind the engine, Major Vincent for a full half hour answered a rapid fire of questions covering every feature of the engine.

The Liberty engine is a success. It has been substantially indorsed by Europe in the shape of orders for large numbers of them, and when it finally carries the American flag over the battle fields of Europe we have every assurance that it will be as good an engine as has as yet been produced. The method by which it has been developed has been more than vindicated, and it is one of the brightest spots in the history of automobile and automotive engineering that all personal factors were forgotten in the harmonious, effective co-operation which resulted in the incorporation of the world's best ideas in the building of the Liberty engine in the short period of 21 days.

Anti-Friction Bearings in Tractor Work

MANUFACTURERS of anti-friction bearings have not been slow to recognize the new field opening up for their products in the tractor industry, and in cultivating it industriously. It is true that the tractor is a slow-speed machine, all its shafting, from the engine crank to the axle, revolving at much lower speeds than the corresponding shafting in automobiles, and also at somewhat lower speeds than in motor trucks. Anti-friction bearings, whose friction-reducing qualities result in the greatest saving in power in high-speed machinery, are therefore not of quite the same advantage as in automobiles, where, of course, nobody would think of using any other type of bearing in the entire transmission line, from the engine back. If anti-friction bearings are desirable on a tractor, it is chiefly on account of their ability to stand up under neglect.

Farm tractors are being operated largely by untrained labor. Men who have been associated with machinery all their lives are fully aware of the absolute necessity of keeping plain bearings supplied with oil at all times. The farm boy 16 or 17 years old is not so familiar with this requirement, and even if he is told once or twice he cannot visualize the result of neglect to attend to the oiling as clearly as the engineer or the trained and long-experienced operator. It generally takes one or more "sad experiences" before the lesson is thoroughly brought home to him. Such lay-ups as result from the burning-out of a transmission or axle bearing right in the midst of the plowing season are a great inconvenience to the farmer, and a tractor that is liable to them is at a serious disadvantage.

Anti-friction bearings, the same as plain bearings, require lubricant, but for an entirely different reason. In a plain bearing, where the surfaces of the journal slide over those of the bushing, the oil serves to keep the metallic surfaces apart and thus prevent abrasion. In an anti-friction bearing, and especially in a ball bearing, the contact surface is so restricted that the existence of a separating film of oil is inconceivable. Moreover, as the motion is

entirely (or almost entirely) of a rolling nature, there is no need for such a separating film, as pure rolling motion does not cause abrasion, provided the load is not too great.

The object of the lubricant in anti-friction bearings is to prevent corrosion. All parts of the bearing, with the possible exception of the cage or separator, are made of steel and therefore sure to rust unless protected by a coat of lubricant.

These anti-friction bearings are generally packed in grease, and one packing lasts for a whole season or longer. Hence they cannot easily be injured by neglect, and that is the reason they are rapidly gaining ground in tractor construction. Of course, their friction-reducing qualities are not to be despised, but they are secondary in importance to their fool-proof feature.

Save $200,000 Per Year

DAILY, some 10,000 men visit Washington from the industrial centers of the United States. They come either to give aid to the government or to secure munitions contracts. It is estimated that the average daily salary of these men is $20. Each day they lose, therefore, means $200,000 lost. And this is the amount that is lost almost daily in Washington because before these men can transact their business they must lose from one to two or three days, and sometimes more, finding the department or individual with whom they should deal.

The government should establish a bureau of information at the Union Depot, where all strangers can immediately learn which individual, what department, and the correct location they need to know. There are now more than 150 large important buildings devoted to war work with many thousands of individuals housed in them, and there is no simple or even intricate method by which a stranger can locate the men he desires to find. The sooner such a bureau of information is established the sooner the government will be able to place its contracts with the proper concerns.

Prepare Now

EVERY manufacturer in the automobile industry who intends to stay in business should prepare now for future uncertainties. Although we have passed the immediate crisis and have convinced Washington by facts and arguments that drastic action against the industry is unnecessary, we are not certain that these same conditions will not arise again.

Now is the time to perfect plans for hauling steel and other materials by motor truck trains.

Now is the time to work for completion and perfection of highways.

Now is the time to perfect plans for substituting female labor for male labor.

Now is the time to arrange for dilution of labor.

Now is the time to arrange passenger travel service by means of passenger motor buses between cities —which is sure to come if passenger trains continue to be curtailed to insure better freight service.

Now is the time to think of substitution of materials.

Now is the time—not to-morrow when shortages are upon us. And the manufacturer who is thinking and planning and doing now is the one who will have no cause for trouble if these various problems do arise later.

For some months during the period when drastic action was thought necessary, statements were made daily to the effect that the automobile industry is the third largest manufacturing in the country, and that with its resources it could always manage if given opportunity, despite any shortage. These words were not designed to temporarily allay fears but are true words and they have the backing of facts. Now is the time they should be proven. To-day the industry has a respite from drastic action of any sort and to-day should be the day of Preparedness against any possible future adverse action.

The same as peace times are the proper time to prepare for war so periods of calm in the development of an industry are the proper periods to prepare to meet aggression in the future. Therefore—prepare!

Engineering Co-operation

INDUSTRIES have been revolutionized, not by the act of one man nearly so much as by the combined efforts of those who knew most about that industry. The discussion of facts rather than the suppression of them is what gives the forward impulse to all the matters which hinge upon that fact. We must constantly develop, and it is certain that we are sure to devolop much more rapidly if our thoughts are co-operative rather than competitive in all branches of our work.

One of the brightest spots of the year has been the increasing spirit of co-operation among the engineering branches of the automotive industry. The use of the S. A. E. as a clearing house where the tractor, truck, marine and motorcycle fields have been able to get in touch with the same spirit of standardization which has put the automobile business on its present high plane of development is sure to prove a substantial stepping stone for these industries.

It is quite certain that this intimate association is going to break down the barriers between these several industries and to merge them into one broad field. This tendency is already quite noteworthy and is exemplified in the exchange of standards which has already taken place.

The fact that the Liberty engine was made possible only through the co-operation of the various engineers intrusted with carrying out certain parts of the program amply proves what can be done in commercial practice. The old day of the secret method has passed. Nothing was ever gained by hiding the light under a bushel and there cannot be a single example pointed out where concerns which have spread the light of their knowledge before the eyes of others in the same field have suffered on that account.

❑ Latest News of the

Production, NOT Restriction, Is Needed

WASHINGTON, Jan. 17—The proclamation of Fuel Administrator Garfield prohibiting the burning of coal for 5 days, namely, Jan. 18, 19, 20, 21 and 22 and on all Mondays beginning Jan. 28 and continuing up to and including March 25 has the approval of President Wilson and is designed to be a quick cure to the most serious coal situation of to-day.

There is a difference of opinion among automotive men in Washington regarding the working out of the Garfield plan. Some feel that he has tried everything except that of increasing production of coal which would naturally be the first step to take.

Christian Girl, who is chairman of the military truck production committee as well as automotive engineering, is glad that the situation has come and that matters have been brought to a head. According to him we will be in serious trouble for a while. This action is really the bursting of the boil.

Mr. Girl believes we attach too much importance to the placing of transportation ahead of production and the problem of placing production ahead of transportation has not been considered. He believes that the freight congestion can be relieved in 6 days and looks to motor trucks as the great factor in accomplishing this.

Hugh Chalmers, of the Automobile Industries Committee, favors Garfield's action of stopping the use of coal for 5 days and 1 day a week until March 25. He believes that this should result in a quick cure of the situation which would be preferable to a dragging illness.

H. L. Horning, chairman of the Automotive Products Section of the Council of National Defense, favors the Garfield action for the reason that we cannot make shipments at present, and he believes it would be better to slow up production temporarily if it will clarify the situation.

Mr. Girl has specific plans as to how he can relieve in 6 days the present freight congestion which is responsible for the situation. His plan, quoting from his own words this morning, follows:

"I would line up all of the trucks in New York City and deliver gratis to all concerns the freight that is now tied up in the warehouses and which is clogging the wheels of distribution. The cost to the Government for this service would be much less than the cost of congestion. One must not only keep the cost of doing things in mind, but also often the greater cost of not doing them.

"I would unload all the Government merchandise which is now filling 50,000 railroad cars at seaport and put this under military

(*Continued on page* 194)

Substance of the Order Shutting Down Business

WASHINGTON, Jan. 16.—Following is the statement issued to-night by H. A. Garfield, Fuel Administrator, regarding the order for fuel conservation:

The order of the United States Fuel Administrator directing the curtailment in consumption of fuel provides substantially as follows:

(1) Until further order of the United States Fuel Administrator, all persons selling fuel in whatever capacity shall give preference to orders for necessary requirements

(a) Of railroads;

(b) Of domestic consumers, hospitals, charitable institutions, and army and navy cantonments;

(c) Of public utilities, telephones, and telegraph plants

(d) Of ships and vessels for bunker purposes;

(e) Of the United States for strictly Governmental purposes, not including orders from or for factories or plants working on contracts for the United States;

(f) Of municipal, county, or State Governments for necessary public uses;

(g) Of manufacturers of perishable food or of food for necessary immediate consumption.

The order further provides that on Jan. 18, 19, 20, 21, and 22, 1918, no fuel shall be delivered to any person, firm, association, or corporation for any uses or requirements not included in the foregoing list until the requirements included in the list shall have been first delivered.

On Jan. 18, 19, 20, 21, and 22, 1918, and also on each and every Monday beginning Jan. 28, 1918, and continuing up to and including March 25, 1918, no manufacturing plant shall burn fuel or use power derived from fuel for any purpose except—

(a) Such plants as from their nature must be continuously operated seven days each week to avoid serious injury to the plant itself or its contents.

(b) Manufacturers of perishable foods.

(c) Manufacturers of food not perishable and not in immediate demand, who may burn fuel to such extent as is authorized by the Fuel Administrator of the State in which such plant is located or by his representative authorized therefor, upon application by the United States Food Administrator.

(d) Printers or publishers of daily papers may burn fuel as usual excepting on every Monday from Jan. 21 to March 25, 1918, inclusive, on which days they may burn fuel to such extent as is necessary to issue such editions as such papers customarily issue on important national legal holidays, and where such papers do not issue any editions on a holiday they are permitted to issue one edition on the said Mondays.

(e) Printing establishments which may burn fuel on Jan. 18, 19, 20, and 22 to such extent as is necessary to issue current numbers of magazines and other publications periodically issued.

On each Monday beginning Jan. 21, 1918, and continuing up and including Monday, March 25, 1918, no fuel shall be burned (except to such extent as is essential to prevent injury to property from freezing) for the purpose of supplying heat for:

(a) Any business or professional offices, except offices used by the United States, State, County, or municipal Governments, transportation companies, or which are occupied by banks and trust companies or by physicians or dentists;

(b) Wholesale or retail stores, or any other stores, business houses, or buildings whatever, except that for the purpose of selling food only, for which purposes stores may maintain necessary heat until 12 o'clock noon; and for the purpose of selling drugs and medical supplies only, stores may maintain necessary heat throughout the day and evening;

(c) Theatres, moving picture houses, bowling alleys, billiard rooms, private or public dance halls, or any other place of amusement.

On the above specified Mondays no fuel shall be burned for the purpose of heating rooms or buildings in which liquor is sold on those days.

No fuel shall be burned on any of the foregoing specified Mondays for the purpose of supplying power for the movement of surface, elevated, subway, or suburban cars or trains in excess of the amount used on the Sundays previous thereto.

The order provides that nothing in this order shall be held to forbid the burning of fuel to heat rooms or such portions of buildings as are used in connection with the production or distribution of fuel.

The State Fuel Administrators are authorized by the order to issue orders on special applications for relief, where necessary, to prevent injury to health or destruction of or injury to property by fire or freezing.

The order is effective in all of the territory of the United States east of the Mississippi River, including the whole of the States of Louisiana and Minnesota.

Automotive Industries

Organize War Work Program

Eighteen Firms Form Lansing Allied Industries—Open Washington Office

LANSING, MICH., Jan. 14—Eighteen Lansing firms have organized as the Lansing Allied Industries to handle government war work, and have opened an office in the Munsey Building, Washington. Government contracts will be passed from factory to factory until they are completed. The concerns in the new organization follow: Gier Pressed Steel Co., Prudden & Co., Novo Engine Co., Auto Body Co., New Way Motor Co., Dail Steel Products Co., Reo Motor Car Co., Michigan Screw Co., Lansing Stamping & Tool Co., Hugh Lyons & Co., Lansing Foundry Co., Eureka Machine Co., Reliance Engineering Co., Lansing Co., Ideal Engine Co., Olds Motor Works, Duplex Truck Co., and the Lansing Forge Co. George F. Bates, Detroit, has been appointed Washington agent.

—

N. A. C. C. in Foreign Trade Convention

NEW YORK CITY, Jan. 16—Through the activities of its Export Committee, the National Automobile Chamber of Commerce will be represented at the National Foreign Trade Convention to be held in Cincinnati in April. The committee took action recommending that a delegate be present at that convention.

Increased activity of the Bureau of Foreign and Domestic Commerce was urged by the Export Committee in a recommendation that this bureau increase the attention it is giving to the investigation of foreign automobile markets by issuing periodical reports relating to automobile conditions in foreign countries.

The Export Committee, under Chairman J. Walter Drake, president of the Hupp Motor Car Corp., looks forward with keen interest to foreign trade after the war, and expects that when export embargoes and import prohibitions have been removed and commerce returns to normal conditions, that there will be a great increase in the demand for automobiles. The committee has issued the statement that 75,000 vehicles worth $80,000,000 were exported last year. These were made up approximately of 60,000 passenger automobiles and 14,000 motor trucks. These figures represent but 4 per cent of the total automobile and truck production of the country and 8 per cent of the gross value of these.

CHARLES F. KETTERING
President S. A. E.

Mr. Kettering was graduated from Ohio State University in 1904. He has been continuously connected with the Dayton Engineering Laboratories Co. since 1909 and is at present its vice-president. Prior to 1909 he was engineer in charge of electrical development for the National Cash Register Co.

Other steps taken by the committee at its meeting held last Thursday were: Recommendations that the N. A. C. C. collect information relating to available highway improvement data, with a view to sending such material to countries where road conditions are in a backward state; and that the N. A. C. C. also undertake the preparation of technical automobile terms used in foreign languages with the thought of formulating a complete list of such terms with their equivalents in different languages.

Over a year ago AUTOMOTIVE INDUSTRIES strongly recommended carrying on a propaganda for good roads in foreign countries, one country in particular where such a propaganda could be carried out being Argentina. South Africa and Australia are other fields.

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McMullen is Chevrolet Sales Manager

FLINT, MICH., Jan. 16—E. J. McMullen has been appointed sales and advertising manager of the Chevrolet Motor Co. He will take the place of J. S. Collins, who resigned, and has started on a 2 months' vacation.

Aviation Chief Topic of S. A. E.

Termination of Thirteenth Annual Session Shows Remarkable Year's Growth

NEW YORK, Jan. 10—The regular winter session of the Society of Automotive Engineers was held here to-day, at the Engineering Societies' Building. The program terminated to-night in a banquet at the Hotel Biltmore, which was attended by 1100 members of the society and guests. This is the 13th annual meeting of the organization which, during the year, has changed its name, being formerly the Society of Automobile Engineers.

Growth in Membership

During the year 1917 the membership of the organization grew from 2120 to 3119, this being largely due to the expansion in the field covered by the organization from the automobile line to embrace also the other automotive industries, including airplane, tractor, motor marine, motorcycle and stationary plants employing internal-combustion engines.

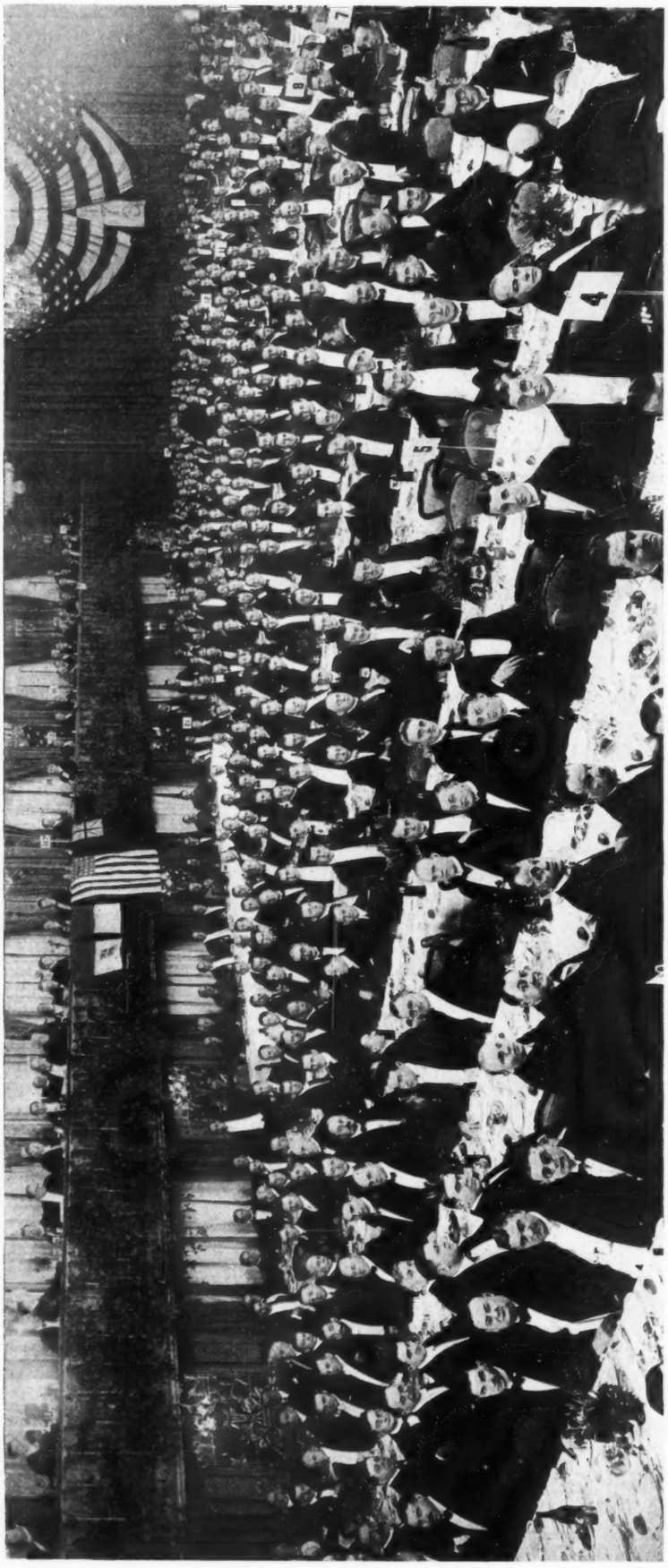
The society is in excellent financial condition, having invested during the year in $24,000 worth of Liberty bonds and more than $12,000 in other bonds and securities. Its work along the lines of standardization has been paid for in part by donations of the automobile and accessory trade organizations. The large addition of members has also brought in a substantial financial return.

Notable Program

A notable program was arranged, the morning being given up to routine matters, such as the business meeting, president's address, election of new officers and standards, while the afternoon was taken up entirely by the professional session.

The latter was the best attended in the history of the organization, the auditorium of the Engineering Societies' Building being packed to capacity throughout the session.

The program for the professional session was divided into three parts, the first being talks on Reasons Behind the Liberty Aircraft Engine, the second, papers on Reasons Behind the U. S. War Truck Design, and the third, a paper on Fuel for Automotive Apparatus. The speakers were: Col. V. E. Clark, Major J. G. Vincent and H. M. Crane on aircraft; C. T. Myers on the War Truck and Dr.



Annual Banquet of the Society of Automotive Engineers, Held at the Hotel Biltmore Jan. 10 and attended by more than 1100 members and guests

E. W. Dean on fuel. Reports of these talks are given on other pages in this issue.

John Kendrick Bangs was toastmaster of the banquet, the speakers being Major J. G. Vincent, Howard E. Coffin, chairman of the aircraft board; Captain M. E. de Jarny, French Military Mission, and Charles F. Kettering, president-elect S. A. E. Speeches were largely devoted to matters pertaining to the war, and the meeting was made the occasion of demonstrations of a patriotic nature and of friendship for the allied nations who were largely represented by officers of the French, British and Italian armies.

S. A. E. Service to Government

George Dunham, in opening the meeting, spoke of the rapid growth of the organization during the past year, and dwelt particularly on the patriotic service rendered to the Government by the organization, and which is clearly recognized by the Government. He told how the word automotive, coined by some of the members as a part of the name of the new organization to indicate its wide scope, has become a general term which is well recognized. The meetings have been well attended, President Dunham pointed out, particularly at Kansas City and Fremont last summer at the tractor sessions and also at the summer session in Washington, where it was necessary to hold an overflow meeting because the capacity of the Bureau of Standards was overtaxed.

President Dunham stated that the Government appreciated the great work of the S. A. E. in connection with the standardized Government trucks, which are in three sizes, and also in the design of the Liberty aircraft engine. This work is going on rapidly, particularly in the standardization of airplane parts, many of the latter standards being adopted by the International Standards Board. The Government's standard motorcycle has not been completed as yet but Society members are doing important work in connection with this design, also. There are now over 125 members of the organization who are commissioned officers.

Two New Sections Formed

Two new sections have been formed, one of these at Buffalo and the other at Minneapolis. The journal of the Society has grown from a small bulletin to an important record of the activities of the organization in all fields. The headquarters of the Society also had to be enlarged.

Reports by the treasurer and by the membership committee showed the Society to be in a healthy state in both directions. The surplus for the year amounted to $16,930.96, the Society having had an income of $113,227.97 and expenditures of $96,297.01. The membership increased by 1000, as indicated in President Dunham's address. Important revisions regarding the qualifications for membership are being studied by a special committee headed by B. B. Bachman, engineer of the Autocar Co., and will be submitted to the members by mail ballot.

The entire report of the Standards Committee was accepted by the association, and, in addition to the work reported in last week's AUTOMOTIVE INDUSTRIES, the marine standards were also adopted as well as those of the Miscellaneous, Tire and Rim and Tractor Divisions.

Another important action taken was to waive the dues of members of the organization who are with the forces in France during the period of the war.

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1500 to Attend S.A.E. Chicago Dinner

Expected War Banquet Will Be Largest in History of Society

NEW YORK CITY, Jan. 14—The War Dinner of the Society of Automotive Engineers, which will be held at the New Morrison Hotel, Chicago, on Friday, Feb. 1, as a climax to the special tractor meeting of the society on the same day, has now come into the spotlight since the New York meeting and dinner has become a matter of history. The Chicago War Dinner promises to be the greatest in the society's history. It will provide comfortable seating for 1500 diners and approximately 1000 seats have been sold already. The special program should stamp the event as perhaps the greatest war dinner of its kind held in Chicago.

To help carry out the war spirit, a $25,000 pipe organ has been specially installed in the hotel dining room. In addition, music will be furnished by an orchestra of thirty pieces, and there will be fifty singers from the Apollo Club, one of the large musical organizations of the Windy City. Only war music will be sung, and a special program of it has been drafted and is being rehearsed. The entire work of the program is being handled by the Mid-West Section, with B. Ayres of the section in direct charge.

The tractor professional session will start at 1:30 p. m. on Friday, Feb. 1, in the Crystal Room of Hotel Sherman. The program, already announced, deals with engineering under such heads as: Fundamentals of General Tractor Design; Fundamentals of Transmission Systems in Tractors; Fundamentals of Engine Design, and Tractor Service. Ample opportunity for discussing these different subjects will be afforded at the meeting.

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Pullman Machinery Sold

YORK, Pa., Jan. 10—The machinery of the Pullman Motor Car Co., reserved at the recent sale of the company's assets, has been purchased by Michael Levy, of Chicago and New York. The buildings, which are owned by Joseph Frankel, New York, will probably be purchased by the Bell Motor Car Co., also located here. Negotiations for the sale of the buildings to the Bell company have been in progress for several weeks.

Fourteenth Annual Banquet of the Motor & Accessory Manufacturers' Assn.

$8,500,000 Profits for Overland

Heavy Expenditures in Changing from War to Peace Basis Reduce Dividend to 4%

TOLEDO, Jan. 14—Willys-Overland has made a reduction of 66 per cent in its quarterly dividend, because of heavy expenditures necessitated by the transition of the plant from a peace to a war basis. The dividend is now 25 cents, payable Feb. 1, to stock of record on Jan. 25. This is equivalent to 4 per cent a year on the $25 par value of the stock, as compared with the usual 12 per cent.

Subject to final audit Willys-Overland earned for the 12 months ended Dec. 31 net profits of $8,500,000. This is figured before the deduction of Federal excess profits taxes, which cannot yet be determined, but which it is estimated will not exceed $600,000. During the final quarter of 1917, the company was in process of transition from a peace to a war basis, in order to care for the manufacture on a large scale of motors and parts for the Curtiss Aeroplane & Motors Corp., as well as for heavy orders for the United States Government.

This has called for large expenditures from earnings for plant additions, new tools, dies, and other equipment. In addition, it has necessitated the accumulation of large supplies of raw and semi-finished materials, the inventory amounting at the close of the year to $39,000,000.

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Revise Method of Show Space Sales

NEW YORK, Jan. 14—If the customary arrangement for the sale of space at dealers' automobile shows is continued, the various associations may have to pay large sums to the government. According to the old arrangement, space was sold at a figure which more than covered the expenses of the show, and most of which was refunded to those who paid for space. Under the excess profits law, a good part of this rebate would be classed as excess profit, and some of it would have to be turned over to the government. This situation arose recently in Cleveland, and after an investigation, Manager Fred H. Caley worked out an arrangement by which all money should be given to him as trustee, and all that is not used will be refunded by him to the dealers. A similar arrangement is being followed in Philadelphia.

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Changes in New York Dealers

NEW YORK, Jan. 15—Several changes have been made along the New York motor row with the coming of 1918.

The Holmes Motor Car Co. of New York has been formed to handle the new Holmes car, made by Arthur Holmes, formerly engineer for the Franklin Automobile Co., Syracuse. The sales manager of the new agency is Frederick K. Jones, formerly with the Franklin agency here. Salesrooms are at 1848 Broadway.

The Dort agency, formerly handled by the C. T. Silver Motor Co., has passed to a new dealer, F. W. Wright, Inc., 225 West 57th Street.

The H. A. Sanders Motors Corp., 1876 Broadway, has taken the Case agency.

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W. H. Strom Heads U. S. Ball Bearing

CHICAGO, Jan. 11—At the last meeting of the board of directors of the U. S. Ball Bearing Mfg. Co. the following officers were elected: W. H. Strom, president and treasurer; E. N. Strom, vice-president; G. A. Strom, secretary.

The change in officers was brought about by the recent death of A. A. Strom, father of the three officers, who during his life was president of the company, but associated with it in an advisory capacity only. The vacancy in the board that his death caused was left open to be filled at the next stockholders' meeting.

No actual change in management has taken place, for W. H. Strom retains the position as general manager which he has occupied for the past five years, during which time he also has been an officer of the board. The new officer is G. A. Strom, who was associated with his father in the Pettibone Mulliken Co. until recently, when he took over the active management of the old U. S. Ball Bearing plant in Oak Park, which is now operated as a subsidiary.

In connection with the change of name of the product of the U. S. Ball Bearing Mfg. Co., from "U. S. Ball Bearings" to "Strom Bearings," it is somewhat of a coincidence that the change of name was publicly announced almost simultaneously with the death of A. A. Strom. It had been decided by active members of the company that, in commemoration of Mr. Strom's very successful activities in the manufacturing world, the name of the product be changed to "Strom Bearings" and one of the last official acts performed by Strom in his advisory capacity with the U. S. Ball Bearing Mfg. Co. was to sanction the change of name. A considerable increase in capacity of the present large plant will be made.

IF your copy of AUTOMOTIVE INDUSTRIES *does not reach you on the day it usually arrives, wait a day or two before writing us about it. It is on the way. These days the railroads are having a hard time and finding it almost impossible to adhere to schedules because of the extraordinary amount of freight which must be handled. Even the United States mails are delayed. Many expert Post Office sorters have enlisted and their places are being taken by less experienced men. So wait a few days before you write us that your copy has not been received.*—AUTOMOTIVE INDUSTRIES.

Australia Faces Car Famine

Embargoes, Strikes and Tire Shortage Sources of Difficulty

SYDNEY, AUSTRALIA, Dec. 15—Australia is facing a genuine motor famine, which is due to a variety of causes. The loss occasioned by different embargoes, has reduced the number of automobiles reaching this continent, and another difficulty is the trouble of getting pneumatic tires. Goodyear has done an immense business in Australia, but owing to shipping difficulties has not been able to keep its stocks here equal to the demand. The tire situation is further aggravated because local rubber companies have suffered production losses due to a labor strike which has been in force 3 months. The road of the local rubber companies has been further blocked by difficulties in securing raw materials for tire manufacture.

It is unfortunate that at this time there should be a shortage of cars and tires, because the farmers are getting large returns for their labors. Good prices are paid for their wheat and wool, and the guarantee of these prices makes the Australian farmer the most prosperous automobile buyer to-day. Crops are particularly good, and farming conditions give promise of being the best in years.

The extra money made by the farmer eventually permeates nearly all departments of business life. It dribbles back to the city to a large extent, thus making the general merchant fairly prosperous, but unfortunately his major trouble to-day is also a shortage of the merchandise he attempts to sell.

One aspect of the shortage of automobiles in Australia is the enormous increase in the price of used cars. There are many used cars of both American and European origin selling at a much higher price than they originally sold at as new machines. This is helping the dealers out very materially.

So far Australia is not confronted with any gasoline famine. In fact no fear is expressed at this time of any fuel shortage.

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Trucks at Milwaukee Show

MILWAUKEE, Jan. 14—Milwaukee's tenth annual motor show, which opens Wednesday evening, Jan. 16, under the auspices of the Milwaukee Automobile Dealers, Inc., will occupy every square inch of space available in the Auditorium building. For the first time in the history of the Milwaukee show it has been found necessary to conduct distinct passenger and commercial car shows. Consequently, the passenger car exposition will hold sway for 7 days, closing Tuesday evening, Jan. 22, and will be followed immediately by a commercial car show, which will last 3 days.

Situation at Capital Unparalleled

Every Government Department Affected by Coal and Railroad Conditions

WASHINGTON, D. C., Jan. 17—These are probably as strenuous days as Washington has ever known, due to the unparalleled situation brought about by the heavy storms and cold weather which has been so general, coupled with the breaking down of railroad transportation and the shortage of coal. The situation is reflected in every Government department, and these are days when careful weighing of conditions are necessary.

The lack of centralized purchasing, and the lack of co-ordination among the different departments have come in for much criticism. It is only natural that with such a condition there should be all kinds of complaints. One of these is that the Government has been shipping only 1½-ton trucks of obsolete and diverse models to France for the Expeditionary forces. This report has been denied by the War Department, which declares that 3- and 5-ton trucks of standard makes have been shipped, but the War Department can not, for military reasons, give the numbers of each shipped.

Some side lights on railroad congestion which in a way accounts for coal shortage has been given out. A report of the Dictator of Railroads shows that sixteen carloads of automobiles for the United States Government have been held in the Philadelphia yards for a long time. A further report shows that 120 carloads of automobiles have been held at Glen Rock for more than 60 days.

A still further abuse of railroad shipping facilities was revealed by a statement that the Government contemplates preferring charges against corporations having Government contracts for war work, and which corporations leave consignments on railroad cars for weeks, and then charge up demurrage to the Government on a cost-plus basis. This statement more or less corroborates and explains an announcement made recently that there were 38,000 railroad cars at tidewater, really serving as storage warehouses.

The Detroit Shell Co. completed its agreement to-day with the Government, the stipulations being satisfactory to both sides. The regular contract will be drawn up and negotiated within the next 2 or 3 months for the total number of shells to be manufactured. From Detroit comes the report that the syndicate will purchase the vacant plant of the Springfield Metal Body Co.

Yesterday a bill was introduced by Senator Chamberlain to exempt Government motor vehicles from all war taxes, when such charges would come out of War Department funds. This would reverse the Treasury ruling made some months ago to the effect that the manufacturers' war tax would have to be paid on all motor vehicles sold to the Government.

A strong feeling is developing in Washington in favor of a centralized or one-man control system for purchasing. The meeting of the Senate yesterday showed many Senators favoring this plan as well as many connected with the Council of National Defense. The value of centralization was shown by Director Walter S. Gifford, who stated that the Council of National Defense saved the United States Government and the Allies from $750 to $900 on each airplane purchased, due to a centralizing effort, and that a further saving of $2,850,000 on the purchase of spruce was accomplished. The saving on the airplanes was due to the agreement regarding reduced royalties on foreign airplane patents.

There is considerable discussion in Washington as to whom the individual will be who will be given control of all purchases for the War Department if the new plan goes through. Speculation includes Daniel Willard, who to-day tendered his resignation to the President from his present position in the Council of National Defense. As we foretold in these columns several weeks ago, Mr. Willard has been considered by the President for Secretary of Munitions. The name of Theodore Roosevelt is on many lips as a proper and logical candidate for the new purchasing job. Many people here are urging him because of his unusual energy and his positive constructive policies.

With the President and Secretary of War Baker decidedly against the creation of a Secretary of Munitions and the Senate decidedly in favor of a new cabinet position controlling all war purchases, it appears as if a compromise will be reached whereby one-man control of war supplies will be provided for under broad powers delegated by the President instead of through the creation of a new department and cabinet member.

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Jobbers Choose Beach as President

NEW YORK, Jan. 16—The National Association of Automobile Accessory Jobbers in annual convention chose as president S. F. Beach of the Motor Car Supply Co., Chicago. The other officers are: Vice-president, P. H. Lyon, Chanslor & Lyon Co., San Francisco; chairman of the board of directors, R. R. Engelhart, Sieg Co., Davenport, Iowa; vice-chairman of the board, William Sparks, Sparks-Withington Co., Jackson, Mich.

The next meeting will be held June 5-12 at Hot Springs, Va., at the Homestead Hotel. The association decided to dispense with its so-called "jobbers" list because its compilation has been a great effort and the results secured were not considered commensurate.

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Jackson Munitions Gets $4,000,000 Order

DETROIT, Jan. 16—The Jackson Munitions Corp. has received a $4,000,000 order from the Government, and it is expected that another of the same amount or larger will be awarded to the company on the completion of the first contract.

Predicts Decrease of Motor Fuel

E. W. Dean Tells S. A. E. End of War Does Not Mean Relief of Situation

NEW YORK, Jan. 12—Decrease in the supply of motor fuel for home consumption during the continuation of the war is the prospect for the immediate future. This is the opinion of Dr. E. W. Dean of the Bureau of Mines, expressed to the engineers. The close of the war will not mean the immediate relief of the gasoline supply situation, according to the government expert. Some of the points made by Dr. Dean follow:

The term "gasoline" is generally recognized to be rather indefinite and to define a product applied to a certain use, rather than a product of any definite property. The best definition of gasoline at present seems to be "a liquid fuel that will start an automobile engine and keep it running after it is going." Any definition that deals with particular and definite performance usually gets in trouble.

Methods of Producing Gasoline

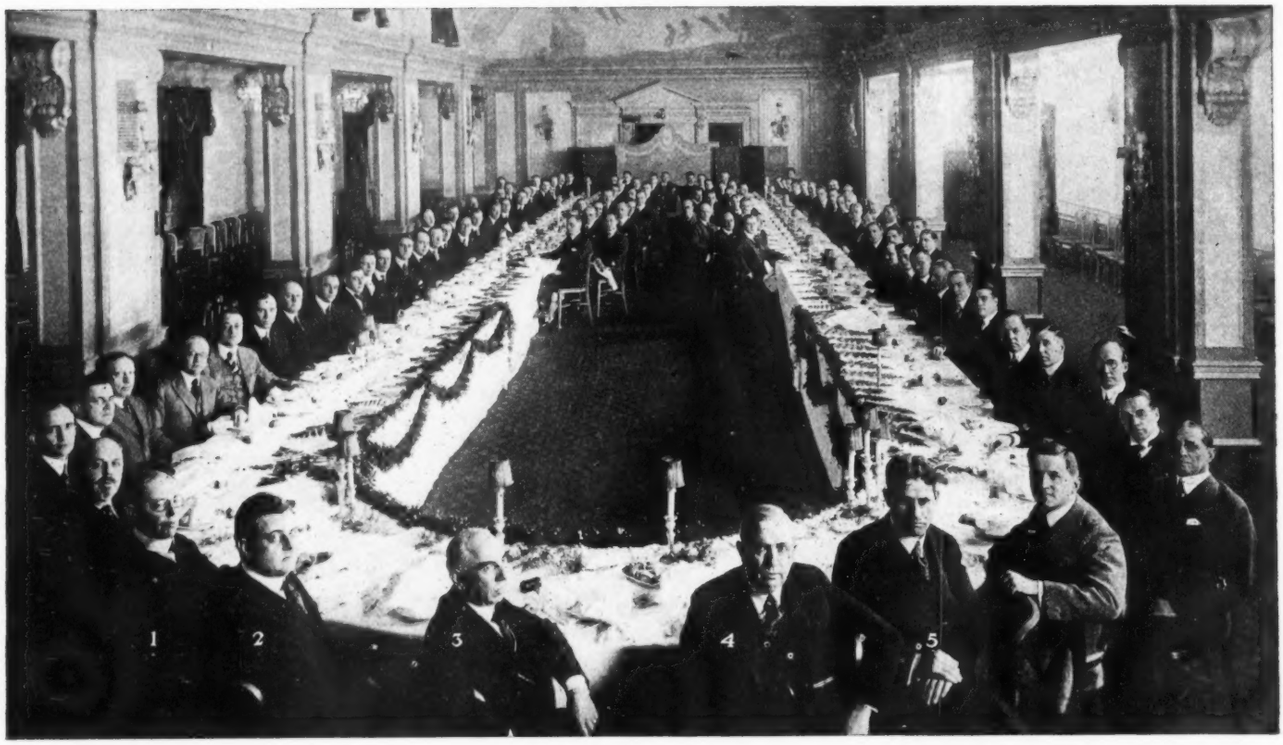
The present refining practice includes three major methods of producing gasoline. One is the ordinary refinery process of distillation from the crude petroleum. The second method is the cracking process. The third is the natural gas method. Large quantities of valuable motor fuel are extracted from certain varieties of natural gas either by processes of compression and condensation or by washing with heavier oils.

These types of products have certain characteristic properties. The straight refinery gasoline is usually composed of hydro-carbons that are decidedly inactive when subjected to chemical treatment. The physical properties of straight refinery gasolines are widely variable in quantity. They depend entirely or practically on the method used in refining gasoline. The most important property from the point of internal combustion engineering is that of volatility. All methods used vary somewhat, but in general they are similar and furnish a satisfactory basis of comparison.

Decrease for Home Use

The prospect for the immediate future during the continuation of the war seems to be that there will be a decrease in the supply for home consumption. It is conservatively estimated that during the present year the military activities will require at least one-fifth of the production, and that this is bound to have some effect on the market. The military gasoline is likely to have higher volatility and for that reason the home market will probably have to make up the difference and use less volatile gasoline. Another possibility is that refiners may have to use less sulphuric acid.

The prospect for relief is not, however,



Representatives of the Class Journal Co., Publisher of Automotive Industries

This is but part of the organization which gathers each year during the New York show. Those who bear numbers are: (1) *E. M. Corey, Treasurer;* (2) *W. I. Ralph, Vice-President;* (3) *H. M. Swetland, President;* (4) *A. B. Swetland, General Manager;* (5) *David Beecroft, Directing Editor of Automotive Industries*

one which the successful termination of the war promises. The supply of crude petroleum, it is estimated, will not last more than another generation and the continuation of actual shortage may result. Prevention of this is imperative.

One of the possible sources of motor fuel in the future is alcohol, but the price of gasoline will have to increase and the price of alcohol decrease before alcohol can successfully compete. Another possible source is coal tar distillates and benzol. These do not seem to promise a large supply.

In the future it appears that all producers in aiding the solution of this problem must procure more motor fuel from petroleum, and designers of engines must work toward higher standards of fuel economy. A certain increase in supply of motor fuel may be counted on in the coal industry.

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New Organization for Little Giant

CHICAGO, Jan. 14—After an existence of 9 years as a department of the Chicago Pneumatic Tool Co., the motor truck interests of the company were on Jan. 1 taken over by a new organization known as the Little Giant Truck Co. The Little Giant Truck Co. is owned and controlled by the Chicago Pneumatic Tool Co. and the officers are the same: W. O. Duntley, president; W. B. Seelig, secretary; L. Beardsley, treasurer, and T. J. Hudson, sales manager.

Hupmobile Foreign Demand Good

DETROIT, Jan. 14—The Hupp Motor Car Co. reports exceptionally good export demand from the Latin countries. It is stated that at present the active demand from South Africa will take 100 cars for immediate shipment and a factory man has been recently taken by the South African dealer to install a service and sales system. The demand from South America and Porto Rico is also good. At present production is far behind the demand and over 100 dealers have not seen the new series R car. The production on this car is rapidly speeding up and at present about 65 cars a day are being manufactured. It is reported on reliable authority that the Hupp Motor Car Co. is doing special work for the Government.

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$15,000,000 Bonds for Curtiss

BUFFALO, Jan. 14 — The Curtiss Aeroplane & Motors Corp. has issued $15,000,000 of first mortgage 6 per cents in six series on Jan. 1. This is to simplify the process of securing advances from the government through the War Credits Board, which are to be made for assisting its production on war contracts.

Series A, of $359,000, maturing Jan. 1, 1919; Series B, of $356,000 maturing Jan. 1, 1920; Series C, of $348,000, maturing Jan. 1, 1921; Series D, maturing Jan. 1, 1922, and Series E, of $1,982,000, maturing Jan. 1, 1923, will be used to retire, on a dollar-for-dollar basis, the present outstanding 6 per cent notes and the gold 6s of 1927. With the shortened maturity, no difficulty is expected, especially as the new notes, like the old, are convertible into common stock at $50 a share, and callable at 102½.

Series F, not convertible, and redeemable at par, is neither to be issued nor sold, but deposited with the government as collateral against the expected advance upon contracts, in order to provide the proper security required by law in case of a government advance. Officials of the company explain that the entire plan is not, strictly speaking, a new financing operation, but is merely intended to simplify the company's financial position in respect to the funded debt, preparatory to the government's advance on contracts. This advance became necessary to give the company a free hand and plenty of working capital for the near future, as the labor of financing its new plant had imposed a heavy strain upon the company's resources.

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Expect Record Minnesota Registration

ST. PAUL, Jan. 14—At the rate of probable gain over the registration of automobiles for the 3-year period just ended of 191,000, the total for 1918-1920 is expected by the secretary of state to reach 225,000. The gain for the last triennial was 54,000 cars. The license fee now is $5 for three years as against

$1.50 before. Motorcycles, which will pay $5, number 11,000 and no increase is expected. To date about 90,000 licenses have been issued. The rush indicates there is more winter and inclosed car driving.

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Government Cars Need No State Licenses

WASHINGTON, Jan. 14—All motor vehicles owned by the Government or operated exclusively by officials or Government employees will not require State licenses or identification tags, according to the War Department. The machines will bear, instead, metal plates issued by the Government or the department which purchased the vehicle. On the plate will be stamped the initials of the department, the letters U. S. A. and the number of the car.

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Changes in Dorris Co.

ST. LOUIS, Jan. 14—George P. Dorris, designer of the Dorris car, has been elected president of the Dorris Motor Car Co. He will succeed W. R. Colcord, who was made president several months ago, when H. P. Krenning sold his interest in the company. Webster M. Colburn, former secretary, but recently not connected with the company, has been appointed general manager.

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Wallis and Case Managers Convene

RACINE, WIS., Jan. 14—A special convention of branch managers of the Wallis Tractor Co. and J. I. Case Plow Co., Racine, Wis., which are closely identified, was held last week at the factories. Although the time of holding a conference was rather unusual, it was arranged to discuss the problems created by the present unprecedented conditions in the industry. H. M. Wallis, president of the companies, who recently returned from a foreign trip lasting 13 months, presented a review of conditions in Europe, based on exhaustive personal observation and analysis.

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$1,000,000 Tire Company Formed

DOVER, DEL., Jan. 14—A $1,000,000 company has been formed to manufacture a puncture-proof tire. The company is styled Puncture Proof In-Tire Co., and was incorporated by C. L. Rimlinger, M. M. Clancy and Clement Egner, Wilmington.

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Route from Buffalo to Coast Planned

WASHINGTON, Jan. 14—The Highway Transport Committee is laying a route directly between Buffalo and the coast. At present three routes are being tried out by Captain Butcher, of the Engineer Corps, and Raymond Beck, head of the touring division of the B. F. Goodrich Co., who has been loaned to the committee for this work. The New York State Highway Department is cooperating with the committee, and is sending a State road inspector along, besides having district road inspectors accompany the party through each district.

Detroit Conditions Unchanged

Dealers Predict Great Spring Rush—Many Store Cars in Preparation

DETROIT, Jan. 10—The automobile industry has moved to New York to attend the show, and no important changes have taken place during the week. The coal shortage continues acute, freight car congestion serious, and manufacturers are still concentrating on their government contracts. There is a strong undertone of increasing confidence for unusually good business in the spring and summer.

This is reflected in the attitude of local dealers, who, because of their proximity to both the factories and the public, can sense coming changes more quickly. A canvas of the larger local dealers shows that there is renewed confidence on the part of the public, indicated not as yet by increased sales, but by the number of unsolicited inquiries.

Guy Ellis of the J. L. Robinson Co., Chalmers and Maxwell distributer, says that the fact that much of the country's ready money is tied up in government work at present is responsible for the quietness of the trade. As soon as munition manufacture starts on a large scale, this money will begin its circulation cycle, and the dealer will receive his proportionate share. At the start of the war, ready money was largely in the hands of the rich. Through the Liberty Loans, it was turned over to the government, and is now being released to the manufacturer. From him it will go to the workmen and retailers.

Applying this theory to the motor car industry, it seems that the wealthy class has practically dropped out of the market, having its money tied up in stocks and Liberty bonds. As a consequence, the old limousine must be used, or a more modest car take its place. The fly-by-night capitalist, with his $5000 limousine, apartment and nothing much else, has also been eliminated. But once the money passes through the hands of the manufacturers to the workmen it will again be distributed through regular trade channels.

Many Detroit dealers are storing cars in anticipation of increased business, some having as many as 150 in reserve. In most instances the number of used cars on hand is large.

At present it is difficult to sell cars on anything but a time-payment basis, and a used car is often taken in trade. The attitude of dealers on the result of this varies, some saying that the demand for used cars will soon be active and others that the reverse will be true. At any rate, used car dealers report a marked increase in sales during the last two weeks, corresponding with a similar increase at this time in past years. Buyers of new cars wait for the shows before buying, but this is not the case with purchasers of used cars, and indications of better conditions are felt in the used car field first.

Dealers are making a special effort to improve salesmanship. Thomas J. Doyle, Dodge distributer, is giving his men an intensive course in salesmanship, and has marked off a separate zone for each man to work in. Bemb-Robinson, Hudson distributer, is sending circular letters to every car owner in the territory. The salesman problem is very bad, since so many of the younger, more aggressive men are in the army.

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200 Commissions for Cleveland Foremen

CLEVELAND, Jan. 14—A campaign for automotive mechanics, similar to the one recently held in Detroit, is being conducted here by Col. Henry B. Joy. Examinations are taken in the Prospect Avenue building of the Packard Cleveland Motor Co. At least 200 machine-shop foremen are desired from this vicinity for commissions in the National Army.

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Daniels Satisfied with Progress

WASHINGTON, D. C., Jan. 14—Secretary of the Navy Daniels expressed himself as being completely satisfied with the progress of the naval aviation program. Machines are being constructed in public and private plants with all possible speed, he stated, and adequate numbers of aviators are being trained. The Secretary added that the Philadelphia Government airplane factory is doing excellent work and that he is also securing many machines from Ford, Packard and other automobile factories as well as from some furniture and piano plants.

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Detroiter Stock to Be Auctioned

DETROIT, Jan. 14—Samuel L. Winternitz & Co. will sell at public auction the entire stock formerly belonging to the Detroiter Motor Car Co., also located here. This stock has an inventory value of more than $75,000 and comprises parts, engines, complete cars, machinery and office fixtures. The Winternitz company purchased the Detroiter company from the Security Trust Co., its trustee, in December.

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Carlisle Distributers Named

NEW YORK, Jan. 14—The Carlisle Cord Tire Co., which was formed May 7, 1917, is rapidly perfecting its system of distribution. A few of the dealers who have recently contracted to distribute Carlisle tires follow: On the Pacific Coast, Tansey-Crowe Co., San Francisco; Kimball-Upson Co., Sacramento; Pacific Tire & Rubber Co., Los Angeles, and San Jose Auto Supply Co., San Jose; in the East, Post and Lester, with their chain of stores operating in Connecticut; Dayton Tire Co., Boston; Invincible Tire Co., Providence; and Del Chase Tire Co., Brooklyn; in the Middle West, Auto Tire Sales Co., Minneapolis; Curtis Rubber Co., Milwaukee; James T. Short, Louisville; and Sherwood-Crippen Co., Columbus, Ohio—and there are many more.

Japan Buying Cars Freely

More Purchasing in All Price Classes Than Ever Before —2400 Cars in Use

NEW YORK CITY, Jan. 16—Automobile conditions in Japan are prosperous and the country is purchasing more large and expensive cars in addition to a good supply of cheap cars than it has ever done in its history, according to Tom O. Jones, who has just returned from an 8 months' trip through the East in the service of the Bureau of Foreign and Domestic Commerce. According to Mr. Jones, there were 2400 automobiles in Japan, and during the first 9 months of last year 600 were imported as compared with 218 during the 12 months of 1916.

Road conditions are not favorable for automobile use in Japan, as roads are generally too narrow with weak bridges, many bridges not being wide enough to accommodate an automobile and not strong enough to carry the lightest car. Prospects for improvement are ahead due to the government spending $2,000,000 on the road from Tokio to Yokohama, as well as ordering other provinces to improve their roads. This government action has been due to the purchase by the government of motor trucks, which cannot be efficiently used without adequate roads.

Mr. Jones in speaking to the export committee of the National Automobile Chamber of Commerce, gave a side light on Japanese truck activity by stating that recently some Japanese army engineers brought an American truck from China with the hope of copying it at the government arsenal, but so much engine trouble followed that the idea of building trucks by the government was given up.

In his trip through the East Mr. Jones made investigations in China, where there is some hesitation in buying cars, due to the fear of the machines being taken from them.

There are practically no roads in China outside of the cities and foreign concessions, but the governors of the provinces are beginning to realize that their districts are handicapped on this account and now propose to build roads to connect towns with the railroads. In and around Pekin there are about 150 miles of roads suitable for automobiles.

After the big flood last summer the Red Cross raised a fund of about $400,000 and the government raised an equal amount, which was used to pay coolies to break stone for construction of the road from Pekin to Tientsin. There is a 1000-mile road from North China into Manchuria on which two light American cars are operated on a regular passenger-carrying schedule, and a proposal is on foot to put a fleet of fifty motor trucks in daily service on this route.

Gasoline was selling in China last summer at 84 to 90 cents a gallon, gold, and in Japan during the last two years at 45 to 50 cents.

Medium-priced cars with small motors and short wheelbase are required in China and Japan, said Mr. Jones. There are about 2100 cars in China, of which 1300 are in Shanghai.

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PRODUCTION, NOT RESTRICTION, IS NEEDED

(*Continued from page* 186)

guard, thereby relieving these freight cars. I would learn all of the purchases made by the Government and while not stopping manufacture of Government work would prohibit all shipments until permitted by Government orders.

"I would prohibit receiving any freight by railroads within 25 miles of any city of 250,000 population or more except by motor truck and would compel prepayment on all freight. The railroad shipping tariffs should be revised so that they can be understood.

"I would take over express companies and use them to handle all freight in less than carload lots. Approximately 100,000 motor trucks should be commandeered and some factories should be commandeered to manufacture standardized trucks.

"I would take over the mails and enlarge them and co-ordinate them with the express system and the railroads, putting them all under one head.

"I would send bill clerks to the freight cars in the yards and have them unloaded on the tracks instead of trying to force all of the freight into the freight houses. This plan would relieve congestion in 6 days without the necessity of shutting down industries and stopping production, which is the great essential of the war."

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New York Zone Plants Alarmed

NEW YORK, Jan. 17—Manufacturers in the zone of Greater New York have received the proclamation of Fuel Administrator Garfield with a great deal of regret, and in general consider it a most undesirable act to stop production when production is so essential.

Due to the shortage of coal not a few manufacturers of automotive products in this zone have been operating on half time. One large maker of accessories has been getting electric power only 3 days a week and has used the power on those days for manufacture and on the other 3 days has done assembly work in which power was not necessary. It has been necessary for him to cut his working force from 500 to 225 men. One very large manufacturer of bearings has cut his working force from 16 hr. per day to 8 hr.

The order is so unusual that few of the companies have had an opportunity of planning on how to meet such a situation. One automobile manufacturer fears that unless the shipment of parts to him is regulated, his factory will be stocked with a much greater quota of parts than he can positively care for and that the channels of manufacture will be interfered with rather than clarified.

Great discontent has been stirred up among laborers who generally live from week to week on their earnings and who see no way of paying for coal if they do not receive wages. New England manufacturers see a grave situation in this aspect. Naturally without employment, workers cannot be expected to carry out their plans for the payment of Liberty Bonds already purchased or to purchase as liberally of future issues. The concensus of opinion is that the country must be kept working and Herculean efforts made to clear the channels of distribution rather than stopping the wheels of production.

Large New York automobile distributing and repair houses have received the proclamation with concern. At this writing they are uncertain whether to close or transact their business from private residences.

Detroit Suffering in Coal Crisis

Look on Fuel Order as Ruinous —Would Cost $1,920,000 a Day

DETROIT, Jan. 17—*Special Telegram*—Detroit automotive factories look upon the Government action of closing industries for 5 days as ruinous, not so much because of the reduction in production but for the fear that thousands of employees cannot financially tide themselves over the period. Such action in Detroit will throw 225,000 workers out of jobs, and the loss will amount to $1,920,000 per day. All large automobile manufacturers agree that the present situation does not call for such drastic action and that some warning should have been given industries in advance.

One of the largest companies in the Detroit zone closed its factory last Saturday in order to furnish coal for its workers. Since then it has opened up several departments for the express purpose of taking care of the idle men on the streets so that they can secure coal to warm their homes, and money to buy food.

The Chamber of Commerce is holding a board of directors meeting to-day to see what assistance it can give the manufacturers. Steam must be kept up in the Detroit factories otherwise the plants will be ruined. Heat can be shut off in the offices, but only a small economy of coal effected. Large automobile concerns in Toledo, Flint, Lansing, Pontiac all agree that the Government action seems unnecessarily drastic, and that the worst phase of it is keeping money away from workmen.

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Toback Made Redden General Manager

CHICAGO, Jan. 16—Samuel S. Toback, formerly one of the largest Hudson distributers in the United States and later distributer of the King and Daniels in New York, has been elected general manager of the Redden Motor Truck Co., Chicago. Toback has also been elected a member of the board of directors. George Hipple, formerly merchandising counsel of the Mitchell Motors Co., Racine, has been elected assistant general manager of the Redden company. A new Redden attachment with a number of improvements is to be brought out.

7000 Mechanics for France

Signal Corps Needs Men for Early Service—Must Be Outside Draft Age

WASHINGTON, D. C., Jan. 14—Seven thousand mechanics are required for early service in France by the Aviation Section of the Signal Corps, the urgency being such that these should leave for France about Feb. 1. Previous to leaving for France they will undergo a short preliminary training at Ft. Hancock. The men are required for various mechanical lines and will be organized into four regiments. Those eligible for enlistment must be outside of draft ages, and the ages desired by the Signal Corps are 18 to 20, inclusive, and 31 to 40, inclusive.

Of the total 7000, approximately 3500 mechanics familiar with gas engine repair, etc., are needed. In addition the classification of men follows:

Automotive mechanics	3500
Ignition men	300
Truck drivers	194
Blacksmiths and forgemen	220
Canvas workers	100
Cabinet workmen	500
Cooks	200
Harness makers	20
General mechanics	400
Lathe men	160
Machinists (planers and millers)	116
Tool makers	640
Sheet metal workers	460
Wheelwrights	220
Welders	80
House painters	40
Sign painters	40

In the organization of these men into regiments the classification is as follows:

Master signal electricians	82
Sergeants, first class	522
Sergeants	1806
Corporals	2064
Privates, first class	2024
Privates	504

The pay for these different classifications covers a wide range. The master signal electricians receive $87 per month, and with allowances for dependents, reaches $129.70. The pay for sergeants, first class, is $53, which, with allowances, reaches $96. For sergeants the pay is $44, which may reach $85 with allowances; for corporals, $36, and to $75 with allowances, and for privates $30 to $68.50 with allowances.

All men enlisting will have to do so through local recruiting offices which are scattered over the country.

This call for skilled workmen offers a very useful field for those desiring to get into this work in France. Undoubtedly these workers will all be located in the great repair and maintenance depots to be established back of the lines in France.

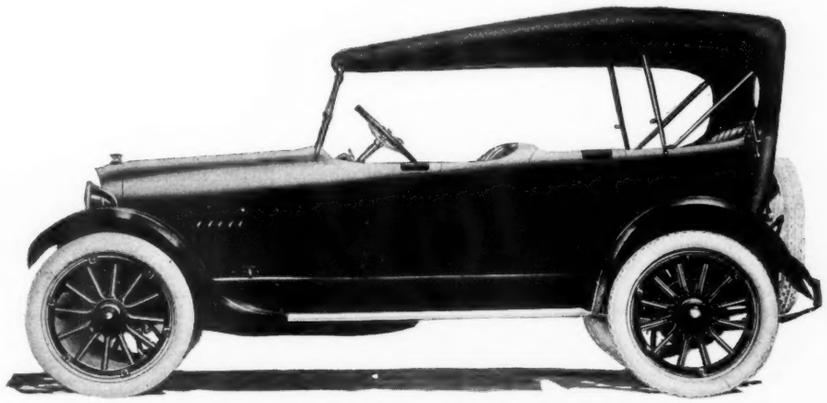
Petroleum Output Breaks Record

1917 Supply Is 341,800,000 Barrels—Increase of 14 Per Cent Over 1916

WASHINGTON, Jan. 15—The quantity of petroleum produced and marketed in the oil fields of the United States in 1917 reached the record-breaking total of 341,800,000 barrels, a quantity nearly 14 per cent greater than the former record output of 300,767,158 barrels, established in 1916, according to preliminary estimates made for the United States Geological Survey by John D. Northrop, its oil statistician.

The oil is apportioned among the major fields as follows:

Field.	1916 Barrels.	1917 Barrels.
Appalachian	23,009,455	24,660,000
Lima-Indiana	3,905,003	3,500,000
Illinois	17,714,235	15,900,000
Oklahoma-Kansas	115,809,792	147,000,000
Central & North Texas	9,303,005	11,000,000
North Louisiana	11,821,642	8,700,000
Gulf Coast	21,768,096	24,900,000
California	90,951,936	97,000,000
Rocky Mountain	6,476,289	9,200,000
Other fields	7,705	.....
	300,767,158	341,800,000



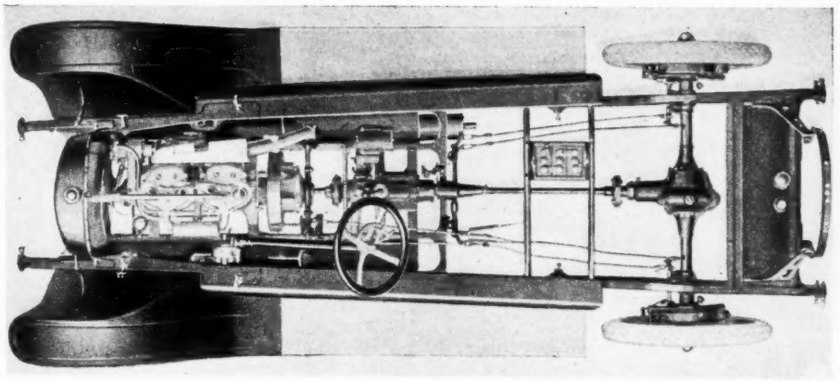
The four-cylinder Reo has a newly designed body which is somewhat lower due to the use of a new rear spring suspension

Reo Four Slightly Altered

A NEW design of body is the principal feature of novelty in the Reo four-cylinder model for 1918. A few notable refinements in engineering detail have also been made and the price has been revised. The wheelbase has been lengthened 5 in. and the Hotchkiss drive adopted. The former model had a torque tube drive, but this has now been abandoned in favor of the Hotchkiss arrangement with underslung semi-elliptic rear springs.

The new wheelbase is 120 in. as against the former 115 in. To take care of this the frame has been stiffened throughout, and in addition the crankshaft has been increased ⅛ in. in diameter and is fitted with counterweights. Aside from this the engine remains the same and the rest of the driving units also are unchanged.

A price increase of $240 was made on Jan. 1, the new price being $1,225. The increase, however, is not merely on account of manufacturing conditions, but is largely due to the fact that the car is larger, roomier and has a much better and finer appearing body. The body has now a center cowl effect, sloping windshield, an improved top with only two bows and a modified gypsy rear, steering column control, and a rear gasoline tank, instead of an under-the-seat type.



The Reo chassis has been slightly altered and is 5 in. longer. The torque tube has been eliminated

To Make 3-Wheel Delivery Car

Is Priced at $295—Will Carry 500 Pounds—Company Has Order for 18,000 Vehicles

NEW YORK, Jan. 14—A new, small, three-wheeled delivery car is being placed on the market by the New York Rotary Motor Co. of which the president is Arthur S. Alexander of the J. Alexander Mfg. Co., an old firm in the trade. Harry S. Houpt, Hudson dealer in New York, is another officer; Colonel Theodore Marceau, a Fifth Avenue photographer, is interested, and the fourth member of the company is John L. Miller, Jr.

The company has an office at 1931 Broadway and a factory at 139th Street and Fifth Avenue. Because of the low price, which is $295, economical operation, and ability to carry a load of 500 lb., its designers believe it will have a large sale. It is said one order for about 18,000 is already in hand and that production will be under way by April 1.

The engine is a rotary type with three cylinders enclosed within the spokes of the driving wheel which is placed at the middle and rear of the three-wheeled chassis. The body is mounted forward on the axle and the driver sits above the motor and behind the body, a form of construction that has been seen before in small package delivery cars.

The motor weighs 34 lb. and, it is stated, will develop 10 hp. and will make 50 miles to the gallon. A maximum speed of 25 m.p.h. is obtainable and the car is said to run for 1½ cents a mile. Tires, which are pneumatic and 30 by 3, are said to give 7000 miles. The whole vehicle weighs 300 lb. Cylinders are 2⅞ by 2½.

Wants Bids for Mail Route

GRAND RAPIDS, Jan. 11—In accordance with the plan of the Post Office Department, the city postmaster is advertising for bids on a postal truck route to be established between this city and neighboring cities. The first route will connect Grand Rapids with Saginaw, a distance of 123 miles, and a trip will be made each way six days in the week. The trucks will carry out the detail functions of a traveling post office and carry produce from the farmer direct to the consumer.

Picard Discontinues Retail Business

NEW YORK, Jan. 14—A. J. Picard & Co., Inc., accessory jobber and distributer, has discontinued its retail store at 1700 Broadway, and will do only wholesale business in the future. The firm has moved to a new building at Broadway and Sixty-first Street.

Saybestos Co. Opens Two Offices

PHILADELPHIA, Jan. 14—The Saybestos Mfg. Co. has opened an office in the Kerr Building, Detroit, under the management of W. C. DuComb, Jr., and another at 608 S. Dearborn Street, Chicago, with Edwin E. Coith in charge.

Kissel Gets $7,500,000 Contract

HARTFORD, Wis., Jan. 10—The Kissel Motor Car Co. has been awarded a government contract for trucks of the Clintonville Four-Wheel Drive type. It is stated that the contract will aggregate $7,500,000.

To Hold Lyons Fair March 1-15

More American Manufacturers Will Attend This Year Than in 1916

PARIS, FRANCE, Jan. 1—The third Lyons Fair scheduled for March 1-15, 1918, gives indication of having a greater number of American manufacturers than attended last year. The French foreign office is extending the utmost consideration to all requests regarding the importation of goods that might be sold through the medium of the fair. This should be beneficial to American exporters who are at present handicapped by restrictions regarding licenses, etc.

As in former years, business at the fair will be carried on by samples, from the booths which are of uniform size, 13 ft. square, each booth constituting a complete shop. There are, in addition to these booths, a number of substantial concrete stands or platforms for the display of heavier articles. Each stand has a surface area of 180 sq. ft. and one exhibitor can lease more than one stand if desired.

Under the rules of the fair the exhibitor is forbidden to deliver any article to buyer during the fair and all retail sales are forbidden during the sales period. The products sold must be forwarded direct from the factory of the exhibitor to the purchaser.

American firms exhibiting at the fair should endeavor to get their products cleared from the port of New York not later than the middle of January if possible.

Automotive Securities Quotations on the New York and Detroit Exchanges

	Bid	Asked	Net Ch'ge
*Ajax Rubber Co.	58	50	..
*J. I. Case T. M. Co. pfd.	76	89	+14
Chalmers Motor Co. com.	2	4	..
Chalmers Motor Co. pfd.	..	50	..
*Chandler Motor Co.	72	73	+ ½
Chevrolet Motor Co.	109	112	—3
*Fisher Body Corp. com.	28	33	—1
*Fisher Body Corp. pfd.	71	80	—7½
Fisk Rubber Co. com.	45	47	+4
Fisk Rubber Co. 1st pfd.	98	103	..
Fisk Rubber Co. 2nd pfd.	60	70	..
Firestone Tire & Rubber Co. com.	98	100	..
Firestone Tire & Rubber Co. pfd.	96	98	..
*General Motors Co. com.	114	115	— ½
*General Motors Co. pfd.	80	82½	—1
*B. F. Goodrich Co. com.	39	41	+1
*B. F. Goodrich Co. pfd.	95	98	+ ¾
Goodyear Tire & Rubber Co. com.	150	154	..
Goodyear Tire & Rubber Co. pfd.	95	97	..
Grant Motor Car Corp.	2	3	..
Hupp Motor Car Corp. com.	2	3	..
Hupp Motor Car Corp. pfd.	75	83	+5
International Motor Co. com.	15	17	+ ½
International Motor Co. 1st pfd.	33	34	—6
International Motor Co. 2nd pfd.	15	20	..
*Kelly-Springfield Tire Co. com.	44	46½	+1½
*Kelly-Springfield Tire Co. 1st pfd.	75	85	..
*Lee Rubber & Tire Corp.	14	15	—1
*Maxwell Motor Co., Inc., com.	25	26	—1¾
*Maxwell Motor Co. Inc., 1st pfd.	57	58	— ½
*Maxwell Motor Co., Inc., 2nd pfd.	20½	22	+ ½
Miller Rubber Co. com.	130	140	..
Miller Rubber Co. pfd.	95	98	..
Packard Motor Car Co. com.	95	103	..
Packard Motor Car Co. pfd.	92	96	..
Paige-Detroit Motor Car Co.	14	16	..
Peerless Truck & Motor Corp.	15½	17	+3
Portage Rubber Co. com.	109	111	..
Regal Motor Car Co. pfd.	..	23	..
Reo Motor Car Co.	16	18	..
*Saxon Motor Car Corp.	8	9	..
Springfield Body Corp. com.	..	..	..
Springfield Body Corp. pfd.	..	..	..
Standard Motor Construction Co.	9	10	..
Standard Parts Co.	65	75	+5
*Stewart-Warner Speed. Corp.	48	50	+1
*Studebaker Corp. com.	50	51	..
*Studebaker Corp. pfd.	91	96	+2
Swinehart Tire & Rubber Co.	16	26	..
United Motors Corp.	22	24	+2½
*U. S. Rubber Co. com.	53	54	..
*U. S. Rubber Co. pfd.	97	98	..
*White Motor Co.	39	40	+1
*Willys-Overland Co. com.	17	18	—2½
*Willys-Overland Co. pfd.	78	82	+5

*At close January 12, 1918. Listed New York Stock Exchange.

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS

	Bid	Asked	Net Ch'ge
Auto Body Co.	7½	8½	..
Bower Roller Bearing Co.	18½	19⅝	— ½
Chevrolet Motor Co.	109	111	—4
Commerce Motor Car Co.	4	..	..
Continental Motor Co. com.	5½	5⅞	— ⅛
Continental Motor Co. pfd.	..	..	..
Edmunds & Jones com.	16	21	..
Edmunds & Jones pfd.	80	90	..
Ford Motor Co. of Canada	195	..	+30
Hall Lamp Co.	13	14½	..
Michigan Stamping Co. com.	12⅜	13	+ ⅛
Motor Products	..	..	..
Packard Motor Car Co. com.	89	90½	..
Packard Motor Car Co. pfd.	90	..	..
Paige-Detroit Motor Car Co.	15½	16⅜	+ ½
Prudden Wheel Co.	14¼	..	+1½
Reo Motor Car Co.	16¾	17	+ ½

INACTIVE STOCKS

Atlas Drop Forge	..	32	..
Kelsey Wheel Co.	80	93	+10
Regal Motor Car Co.	..	26½	..

Industrial Review of the Week

A Summary of Major Developments in Other Fields

A New Service

¶Herewith AUTOMOTIVE INDUSTRIES *supplies for the benefit of its readers a general summary of important developments in other fields of business. This is rendered possible by the editorial co-operation of leading industrial publications which are recognized authorities.*

By compressing the general industrial situation into this form we hope to give our readers a clear and comprehensive idea of up-to-the-minute developments which they could otherwise secure only with considerable expenditure of time and effort.

Coal Distribution Needs Speeding Up

The production and distribution of anthracite is proceeding as rapidly as transportation facilities will permit. This is not, however, fast enough to satisfy the demand. The various local fuel administration boards and committees are perfecting their organizations, the efforts to relieve congestion on the railroads are beginning to make themselves felt, there is a slightly better car supply, and it is believed that conditions in general are easier than they have been in the recent past. It can hardly be expected that Government regulation of the railroads will work any miracle to coal distribution. It is believed, however, that the beginning of better transportation facilities has been made. From all over the country the demand of industrial consumers, especially for bituminous, are heavy, and it is feared that in many localities, even in spite of such economy measures as lightless nights and the like, many industrial plants will be compelled to suspend operations. Conditions in New England along this line became especially acute, and a priority order was issued for the shipment of 500 cars daily to the New England administrator, to be distributed by him as necessity might dictate. It was feared that this priority order to New England would curtail the supply of fuel to other parts of the country, such as New York City and its vicinity, and a request was immediately dispatched to the National Fuel Administrator, urging that this order be rescinded. This request was denied, and it is feared by many that serious economic results will follow. This will not necessarily be the case, provided increased transportation can be secured. Throughout the West and Middle West the situation has been somewhat relieved. Coal standing on tracks in various railroad yards has been in several instances commandeered by local fuel authorities, with the result that temporary local stringency has been to a greater or less extent relieved. The production prospects are in several instances somewhat better than a week or two weeks ago. In the Pittsburgh district several operators of small mines were arrested for evasion of the Government price. The tonnage involved in these evasions was almost insignificant. The conditions in the manufacturing centers of the Middle West such as Detroit, Chicago and St. Louis, have been somewhat relieved during the past week. A freer movement of coal over the railroads has effected this change. The needs of St. Louis are for the time being at least well provided for. Chicago has received heavier shipments, but no stocking could be accomplished. Detroit, also, has received more coal during the past week than the previous one, but this has had little effect upon dealers' yards or the supplies held by them. Many domestic consumers in Detroit have suffered severely during the past month. In the extreme West it is believed that the situation will be somewhat relieved by the substitution of coals mined near at hand in place of the somewhat better fuel brought in by long railroad hauls. The shipment of coal from docks in Milwaukee to the states lying to the northwest has ceased, and it is believed that Wisconsin's supply for the present winter is both ample and secure. There is nowhere manifest a disposition to be critical as to the kind or quality of fuel secured. The principal concern of consumers, both industrial and domestic, is to get coal—something that will burn and generate heat, and the question of whether it is lump, egg or screenings is of entirely secondary importance. While many localities are still on the ragged edge of want, and nowhere does the supply equal the demand, it may be safely said that the situation as a whole is better than it has been in the recent past.—*Coal Age.*

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Fuel Shortage May Cripple Steel Industry

Heavy snows and intense cold have made the breakdown of railroad service more complete in the past few days, and in the shutting down of operations the week has been probably the worst the steel industry has known. It is difficult to measure the loss of output. In the Chicago district the total pig iron production for the past five days has been 30 to 40 per cent of normal, with steel production somewhat more. Pittsburgh, Youngstown and Cleveland have probably had a 60 to 70 per cent operation in steel. Eastern blast furnaces and steel plants have suffered severely from the blockades in other sections, which cut off coal and coke.

The complete shutdowns of some plants have been a matter of but 2 or 3 days, and this phase may pass quickly, but the piling up of freight will hamper mills for weeks, and since mines cannot ship coal unless cars come back as empties the fuel shortage will cripple the industry indefinitely.

A grave situation opens before certain merchant furnaces in the threatened diversion of their coke supply to steel company furnaces. Eastern pig iron producers hasten to Washington this week to protest against an order that will take 100,000 tons of coke a month from them and give it to two Eastern steel companies whose output of plates and ordnance is of the highest importance to the Government. The order was not made effective Jan. 16, as planned, but the postponement is probably temporary. It is a case of putting one Government need before another, as much of the merchant pig iron that would be cut off has been going into contract work for the Government.

The American Iron and Steel Institute's steel committee has just appointed a sub-committee to operate with the director-general of railroads in improving traffic conditions as they affect iron and steel works. This committee's immediate problem will be to move the huge accumulations of finished material that have brought many rolling mills to a standstill. Hundreds of tons of export steel is involved, and the ships to carry much of it wait on bunker coal.

The sharp cutting down of steel output points to a tighter drawing of the lines against less essential industries in the distribution of mill products. More labor would thus be turned upon imperative Government work.

What is most serious in any proposal affecting iron production, such as the order taking coke from merchant furnaces, is the loss of organization where the shutdown is complete. The alternative of repeated bankings of furnaces, while wasteful of coke, would obviate the scattering of working forces.

The uncertainties of Government prices are a brake upon market activity in every form of finished steel. Some lower prices have been quoted for export—3.75c., for example, on steel bars and shapes, and the domestic price of 3.50c., Pittsburgh, for bar iron.

Some large-lot inquiries for shell steel for the British Government have come out, as well as one for plates. An eastern mill will furnish 8300 tons of plates to the British Commission.

While Government priority for rail, car and locomotive steel is fully expected, no definite program for such buying is announced, though rail requirements for 1918 have been put as high as 4,000,000 tons—*Iron Age.*

Men of the Industry

Changes in Personnel and Position

Otis Friend Returns to United Motors Co.

RACINE, Jan. 14—Otis C. Friend, who recently resigned the presidency of the Mitchell Motors Co., has returned to the United Motors Co. and re-assumed the duties of vice-president. He is at present on a vacation in California and it is expected will resume his duties Feb. 15.

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G. L. Barrett has been appointed manager of the southwestern division of the Philadelphia Storage Battery Co., Philadelphia. His headquarters will be at 2605 Locust Street, St. Louis. Barrett was formerly president and general manager of the Willard Storage Battery Co. of Texas.

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R. D. Collins, vice-president of the Jones Motor Car Co., has severed his connection with the company. He has not made public his plans for the future. No successor has been elected as yet.

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C. S. Crawford, formerly chief engineer of the Premier Motor Corp., Indianapolis, is now chief engineer and assistant general manager.

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C. B. Chamberlain has been appointed general purchasing agent for the U. S. Motor Truck Co., Cincinnati. He was formerly connected with the Gramm-Bernstein Co., Lima, O.

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Charles A. Dana, president of the Spicer Mfg. Co., Plainfield, N. J., has been elected to general partnership in the banking firm of William Morris Imbrie & Co., New York. Dana is also vice-president of the New York and New Jersey Water Co., the New Jersey Suburban Water Co., and the Essex Pumping Co.

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C. M. Carr has been elected president of the Planetary Roller Bearing Co., Chicago. He was formerly managing editor of the American Garage and Auto Dealer, a trade publication founded by him two years ago.

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E. K. Conover, formerly manager of the windshield department of the Paige Steel & Wire Co., Adrian, Mich., has become associated with the windshield department of the Zenite Metal Co., Indianapolis.

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R. E. Benner has started work as factory manager of the H. H. Franklin Mfg. Co., Syracuse, N. Y. He was formerly designer of the Maxwell car, and until recently was employed by the Buick Motor Co.

George D. Kershaw has been appointed general works manager for the Standard Aeroplane Corp. of New Jersey, Elizabeth, N. J.

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I. D. Landis has been appointed sales manager of the Elkhart Carriage & Motor Car Co., Elkhart, Ind., and has already assumed his new duties. He was formerly advertising manager and director of sales correspondence for the Crow-Elkhart Motor Co.

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Russell T. Gray, formerly advertising manager of the Haynes Automobile Co., has entered business for himself as advertising engineer, and has opened offices in the First National Bank Building, Chicago. He will make a specialty of mechanical and merchandising advertising in trade papers.

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D. B. Williams has joined the Clydesdale Motor Truck Co., Clydesdale, Ohio. He was formerly with the Mutual Motors Co., Jackson, Mich.

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L. P. Murray, formerly Mid-Western manager of S. F. Bowser & Co., Inc., Toronto, Ont., has been appointed Canadian manager of the company. He will succeed Harry Christie, who has become the head of the company's Canadian sales organization.

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H. S. Benjamin, formerly in the sales department of the National Cash Register Co., has been appointed sales manager of the Saxon Motor Car Co., Detroit.

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E. D. Mismer, formerly of Detroit, has been appointed general manager of the Traverse City Motor Car Co., Traverse City, Mich.

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Walter Davidson, president and general manager of the Harley-Davidson Motor Co., Milwaukee, has been elected a director of the Wisconsin National Bank of Milwaukee.

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W. W. Fickling, formerly connected with the Olds Motor Works, Lansing, and later with the Cadillac Motor Car Co. and the Garford and Gramm-Bernstein companies in the truck field, has joined the forces of the Fulton Motor Truck Co., Farmingdale, Long Island, N. Y.

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Austin M. Wolf has resigned from the American Motors Corp., Plainfield, N. J. He has not as yet announced his plans for the future.

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Samuel W. Gray, for one and one-half years engineer with Reed & Glaser, Indianapolis, has joined the Aviation Reserve Corps as First Lieutenant and has reported to Washington for service.

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A. H. Dewees, formerly purchasing manager of the Saxon Motor Car Corp., has been appointed purchasing manager of the Remington Bridgeport, Conn., plant of the Remington Arms Union Metallic Cartridge Co. Mr. Dewees assumed his duties there on Jan. 1.

New Companies Formed

Latest additions to ranks of Automotive Industries

To Make One-Man Agricultural Tractor

NEW YORK, Jan. 16—The World Harvester Corp. has been formed with $1,500,000 capital to manufacture a two-wheeled, one-man farm tractor and plow combined. It is equipped with a single-cylinder, four-cycle, 3¼ by 5 water-cooled engine, weighs 650 lbs., is stated to develop a drawbar pull of 250 lbs. and sells for $300. It is to be sold under the style Auto-Tiller. Officers of the corporation are: President, C. M. Wheeler, Crocker Wheeler Co., Ampere, N. J.; vice-president, A. B. Phillips, Wahlstrom Tool Co. and American Machine & Foundry Co.; treasurer, George E. Hoyer, cashier, East River National Bank, New York; secretary, Leslie Stevens, Stevens & Co., Inc., New York; engineer, William P. Kennedy, New York.

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Western Machine Products Co. Formed

CLEVELAND, Jan. 14—The Western Machine Products Co. has been incorporated for $100,000 and will take over the land and building of the Marvel Accessories Mfg. Co. In addition to the regular line of the old company, a special group of products will be manufactured. L. A. Katz has been elected president.

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LITTLE ROCK, ARK., Jan. 16—The Arkansas Motor Truck Co. has been incorporated with $10,000 capital stock and will manufacture industrial vehicles. Incorporators are S. M. Bolton, H. C. Wilson and J. O. Evatt.

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ELKHART, IND., Jan. 16 — Peck Super Heat Co. has been formed to manufacture automobile accessories. The capital is $10,000. Incorporators are Raymond G. Peck, Carl E. Mischler and H. J. Rife.

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DOVER, Del., Jan. 10—The Quaker Motor Truck Mfg. Co. has been incorporated here to manufacture motor cars and trucks. The company will have $1,000,000 capital stock.

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DETROIT, Jan. 16—The Saxon Motor Car Corp. is pushing work on its new plant as fast as labor and material will permit and it is expected that within 30 days it will be completely enclosed and that manufacturing will start within 90 days. H. S. Benjamin has been appointed sales manager. He was formerly connected with the National Cash Register Co.

Disco Starter Reorganized—To Make Ford Equipment

DETROIT, Jan. 15—The Disco Electric Mfg. Co. has taken over the bankrupt Disco Electric Starter Co. and is planning extensive manufacture of Disco starters for Ford cars. Nothing has been carried over from the old company except the name "Disco," for both the capital and personnel are entirely new. Dean Emerson, of the Wagner Electric Co., has been appointed general manager. Harry F. Prescott, formerly with the Saxon Motor Car Co., is sales manager. A new building, which was occupied by the old company for a short period, is being used. The company is in a position to manufacture practically any electrical equipment for motor cars and it is rumored that it may enter this field.

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Government Work for Jorgenson

WAUPACA, WIS., Jan. 14—The Jorgenson Mfg. Co., maker of gas engine primers, carbureters and other parts, accessories and supplies, has received a large order from the Government for small castings and parts for military trucks.

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Four Drive Tractor Plans Addition

BIG RAPIDS, Mich., Jan. 11—The Four-Drive Tractor Co. is planning to erect an $8,000 addition to allow for increased production. Later $20,000 in additional stock may be issued.

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Calgary Iron Works Making Parts

CALGARY, Alta., Jan. 12—The Calgary Iron Works, Ltd., has completed a contract for shells, and is now engaged in the manufacture of parts for "Bull" tractors. These parts include wheels, gears, pinions and pistons used on large oil, gas and steam tractors.

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Cochrane Foundry to Move

YORK, Pa., Jan. 10—The John H. Cochrane Brass Foundry, manufacturer of aluminum, brass and copper castings for automobiles and airplanes, will move shortly to the plant formerly owned by the York Bridge Co. The main building is 380 x 60. The company is working on a government contract.

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Topp-Stewart Buys Power Site

CLINTONVILLE, WIS., Jan. 14—The Topp-Stewart Tractor Co., which is ready to undertake the regular production of farm and general utility tractors in its new plant, has purchased two water power sites on the Embarrass River, near Clintonville, and will erect a hydro-electric plant developing about 800 hp. The installation will provide electric power for the Topp-Stewart plant and the surplus will be purchased by other Clintonville industries.

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Collier to Increase Capacity

BELLEVUE, OHIO, Jan. 14—The Collier Motor Truck Co., recently moved from Sandusky, is planning a rapid increase in production in the next few months. The organization is completed and contains prominent executives from parts manufacturing plants who supply the parts for the Collier ¾-ton truck. R. A. Palmer is managing director, M. E. Crow of the Crow-Elkhart Motor Car Co. is president, S. H. Penfield, vice-president of the Salisbury Wheel & Mfg. Co., is vice-president, W. J. Collier is secretary and treasurer, J. F. Corl, formerly general manager of the General Motors Truck Co., is director of sales. The new factory has a capacity of approximately 25 trucks per day, only one model being manufactured, a ¾-ton truck selling for $885.

Current News of Factories

Notes of New Plants—Old Ones Enlarged

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Empire Tire Expands

TRENTON, Jan. 16—The Empire Tire & Rubber Co. is expanding its plant and will double its capacity.

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To Make 1500 Famous Trucks in 1918

ST. JOSEPH, Mich., Jan. 11—The Famous Truck Co. plans the production of 1500 trucks during the coming year, all of which are contracted for already. Three truck sizes are manufactured, a ½-ton, a ¾-ton, and a 1-ton model. These are completely equipped with bodies manufactured in the plant.

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British Aircraft Engine Inspection

(*Concluded from page* 168)

ings gaged and fitting of taper gear tested. Stamped with view mark.

36. Split pin hole for castle nut at taper gear end of shaft drilled, also hole in sleeve nut drilled.
37. Journals stoned for removal of frays, etc.
38. Journals bedded in crankcase bearings.
    Viewed at work bench and stamped.
39. Fitting connecting-rods to pins and stamping recognition numbers on webs and connecting-rods.
    Viewed at bench for play in connecting-rods.

This completes the actual operations of production on the crankshafts and they pass on to the erectors' charge hand for assembling with an engine. This charge hand again generally inspects the whole shaft before allowing it to be assembled in an engine.

The engine then passes on to the test bench for a three hours trial, after which it is stripped in the stripping shop and the crankshaft minutely examined before reassembly, after which it undergoes the final running test on the test bench, and if satisfactory is sent to the despatch shop.

Continental Motors and Linderman Plan Additions

MUSKEGON, Mich., Jan. 14 — Two large additions are to be made immediately to local plants. The first is that on the Continental Motors Corp. plant, comprising a building 400 x 180, and requiring the employment of from 300 to 500 more men. This is to be a sawtooth building of brick and steel construction, and will doubtless be used in the manufacture of two sizes of truck engines. The Linderman Machine Co. has started the erection of an addition 400 x 75, which will provide for the comfort of the workmen as well as increased production. The addition is to contain a rest room, shower bath, and other comforts.

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Auto Body to Increase Production

LANSING, Jan. 14—The Auto Body Co. will manufacture 75 additional bodies daily, beginning Feb. 1. The company has received an order from the Scripps-Booth Corp., Detroit, for 12,000 bodies, and work on this contract will be started Feb. 1. At present, the production amounts to 300 bodies daily, of which 100 are sent to the Olds Motor Works.

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Walton Body to Make Airplane Frames

NEW YORK, Jan. 13—The Walton Auto Body Co. has leased for 5 years a 4-story building at Avenue D and Eleventh Street. This is being equipped with machinery for the manufacture of airplane frames.

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Tractor Radiators, Their Calculation and Design

(*Continued from page* 181)

fan sizes and fan speeds will about meet the suggested power limitation requirements:

Engine Hp.	Fan Hp.	Air C.F.M.	Fan Dia.	Fan R.P.M.
20	.60	4,000	18 in.*	1,600
25	.75	5,000	18 in.	1,600
30	.90	6,000	20 in.	1,500
35	1.05	7,000	22 in.	1,400
40	1.20	8,000	24 in.	1,400
50	1.50	10,000	26 in.	1,400

*Narrow Blade.

In making this plea for larger fan sizes and slower speeds, I have in mind not only economy of operation, but also the alleviation of a number of annoyances such as lubrication, bearing troubles, belt slippage and breakages, all of which we are all too familiar with, and which are all incident to high fan speeds and overloading.

While I have only touched on the fan question lightly, it is one that as applied particularly to the tractor industry should be well worth the attention and study of our fan manufacturers, and I hope that the leaders will be far-sighted enough in uncovering their trade data to give us full and open information on the subject.

In conclusion, if I have been able to demonstrate that cooling troubles are not always the fault of the radiator, and if I have been able to convince you of the desirability of adopting some degree of standardization of the essentials of cooling, I shall, indeed, feel very satisfied.

Company to Operate Truck Trains

DETROIT, Jan. 14—A $1,500,000 corporation, headed by Albert Reiss, a retired commission merchant, has been formed by Detroit, Toledo and Chicago business men to operate 100 trucks between these cities. The trucks will run in trains of 5, each train carrying 10 drivers and 2 mechanics. A tentative schedule allows 12 hr. for the trip from Cleveland to Toledo, and 5 hr. from Toledo to Detroit, 18 hr. from Toledo to Cincinnati, and 24 hr. for the trip from Toledo to Chicago. An option has been taken on a service site in Cleveland.

Trus-Con Paints for Automobiles

DETROIT, Jan. 15—The Trus-Con Laboratories which for the last 8 years has specialized in the manufacture of technical paints and varnishes, will manufacture paints, colors, color varnishes, clear varnishes and baking japans for automobiles, trucks, tractors and machinery. R. Alfred Plumb has organized the new department.

Military Truck Production Section to Move

WASHINGTON, Jan. 14—The Military Truck Production Section of the Quartermaster Corps, headed by Christian Girl, will move to the Union Depot Office Building from its present quarters on I Street before the end of this month. By having all the offices of the engineering, maintenance and production of quartermaster trucks under one roof. Mr. Girl will be better able to supervise all this work.

Calendar

ASSOCIATIONS

Feb. 4-7 — St. Louis, American Road Builders' Assn. Convention.

April 18-20—Cincinnati, Fifth National Foreign Trade Convention.

GENERAL

Jan. 16-20—World's Salesmanship Congress, Third Annual.

Jan. 29-31—Chicago, Annual Convention, Garage Owners' Assn. of Ill., Green Room, Congress Hotel.

SHOWS

Jan. 14-19 — Rochester, N. Y., Tenth Annual Exposition Park. C. A. Simmons, Mgr.

Jan. 16-25 — Milwaukee, Wis., Milwaukee Automobile Dealers, Inc., Auditorium. (First 7 days, passenger cars; last 3 days, commercial cars.) Bart J. Huddle, Mgr.

Jan. 18-24 — Des Moines, Ia., Ninth Annual Passenger Car and Second Annual Truck, Des Moines Automobile Dealers' Assn., Coliseum. C. G. Van Vliet and Dean Schooler, Mgrs.

Jan. 19-26—Detroit Automobile Dealers' Assn., Overland Bldg. H. H. Shuart, Mgr.

Jan. 19-26 — New York Motor Boat Show, Grand Central Palace, National Assn. of Engine and Boat Manufacturers.

Jan. 19-26—Detroit, Willis Avenue Overland Service Station.

Jan. 19-27 — Cleveland, Seventeenth Annual. Cleveland Automobile Show Co., Wigmore Coliseum. Fred H. Caley, Mgr.

Jan. 19-26 — Montreal, Can., Montreal Automobile Trade Assn., Ltd., Almy Bldg. T. C. Kirby, Mgr.

Jan. 21-26—Manchester, N. H., Academy. Couture Bros.

Jan. 21-26—Scranton, Pa., Scranton Motor Trades Assn., Armory. Hugh B. Andrews, Mgr.

Jan. 21-26 — York, Pa., Queen Street Tabernacle, York Automobile Dealers' Assn.

Jan. 21-26 — Wilmington, Del., Hotel Du Pont.

Jan. 21-26—Buffalo, N. Y., Buffalo Automobile Dealers' Assn., Broadway Auditorium.

Jan. 21-26—Richmond, Va., Richmond Automobile Dealers' Association, First Regimental Armory. Henry B. Marks, Mgr.

Jan. 22-24—Montreal, Can., Convention of All Men Interested in the Automobile Industry in Eastern Canada.

Jan. 22-25—Oklahoma City, Oklahoma City Motor Car Dealers' Assn. Carhart Building.

Jan. 22-26—Baltimore, Md., Baltimore Automobile Dealers' Assn. and Automobile Club of Maryland, 5th Regiment Armory.

Jan. 22-26 — Oklahoma City, Okla., Oklahoma City Automobile Dealers' Assn., 701 No. Broadway. Roy H. Haun, Mgr.

Jan. 23-28—Allentown, Pa., Lehigh Auto Trade Assn., Traylor Motor Co.'s Garage. P. W. Leisering, Publicity Mgr.

Jan. 26-Feb. 2 — Chicago National Show, Coliseum and Armory, National Automobile Chamber of Commerce.

Jan. 26-Feb. 2—Chicago, Salon, Elizabeth Room of Congress Hotel.

Jan. 26-Feb. 2—Bridgeton, N. J., Bridgeton Auto Dealers' Assn. O. P. Riley, Sec.

Jan. 26-Feb. 2—Harrisburg, Pa., Capital City Motor Dealers' Assn. J. Clyde Myton, Mgr.

Jan. 26-Feb. 3—York, Pa., York County Auto. Dealers' Assn., Tabernacle, T. F. Pfeiffer, Sec.

Jan. 28-Feb. 2—Buffalo, N. Y., Buffalo Automobile Dealers' Assn., Broadway Auditorium.

Jan. 28-Feb. 2—Manchester, N. H., Academy. Couture Bros.

February — Greensburg Pa., Westmoreland Automobile Dealers' Association.

Feb. 2-9—Twin City Auto Show and Industrial Exposition, Overland Bldg., Midway, St. Paul and Minneapolis.

Feb. 5-9 — Kalamazoo, Mich., Kalamazoo Automobile Dealers' Assn., Armory.

Feb. 5-9—Binghamton, N. Y., Binghamton Automobile Dealers' Assn., Kalurah Temple. William M. McNulty, Mgr.

February — Peoria, Ill., Peoria Auto and Accessories Dealers' Assn. W. O. Ireland, Mgr.

Feb. 6-9—Lancaster, Pa., Automobile Track Assn., Fidelity Bldg. R. W. Shreiner, Mgr.

Feb. 7-13—Portland, Ore., Ninth Annual Dealers' Motor Car Assn., Auditorium. M. O. Wilhin, Mgr.

Feb. 9-16 — Bronx, N. Y., 2d Battery Armory, Bronx Automobile Dealers' Assn. D. J. Barrett, Mgr.

Feb. 11-17—Toledo, Terminal Auditorium, Toledo Auto Show Co.

Feb. 11-14—St. Louis, Mo., St. Louis Auto Mfrs. & Dealers' Assn. Robert E. Lee, Mgr.

Feb. 11-16 — Kansas City, Mo., Kansas City Motor Car Dealers' Assn., Convention Hall. E. E. Peake, Mgr.

Feb. 11-16—Kansas City, Mo., Third Annual National Tractor Show.

Feb. 16-23 — Hartford, Conn., Hartford Auto Dealers' Assn. State Armory. B. F. Smith, Mgr.

Feb. 16-23—Albany, N. Y., Albany Auto Dealers' Assn. State Armory.

Feb. 18-23—St. Louis, St. Louis Automobile Manufacturers' & Dealers' Assn.

Feb. 16-24—San Francisco, Cal., San Francisco Dealers' Assn., Exposition Auditorium. G. A. Wahlgreen, Mgr.

Feb. 18-23—Syracuse, N. Y., Syracuse Automobile Dealers' Assn., State Armory. Harry T. Gardner, Mgr.

Feb. 18-23 — Nashville, Tenn., Nashville Auto Trade Assn., Hippodrome.

Feb. 18-23—Grand Rapids, Mich., Automobile Business Assn., Klingman Building. Ernest T. Conlon, Mgr.

Feb. 18-23—Newark, N. J., N. J. Auto Exhibition, Co. G, First Regiment Armory. Claude E. Holgate, Mgr.

Feb. 18-23—Des Moines, Ia., Des Moines Automobile Dealers' Assn., Coliseum. C. G. Van Vliet and Dean Schooler, Mgrs.

Feb. 18-23 — Springfield, Ohio, Springfield Auto Trades Assn., Memorial Hall. C. S. Burke, Mgr.

Feb. 18-23 — Waterbury, Conn., United Shows Co.

Feb. 18-23—Duluth, Minn., Duluth Automobile Trade Association. John J. Lane, Mgr.

Feb. 18-25 — Pittsfield, Mass., State Guard, State Armory. James J. Callaghan, Mgr.

Feb. 18-27—So. Bethlehem, Pa., Fourth Annual (cars 18-23; trucks 25-27), Coliseum. J. L. Elliott, Mgr.

Feb. 20-23—Quincy, Ill., First Annual, Armory. L. B. Bartlett, Mgr.

Feb. 23-Mar. 2—Brooklyn, N. Y., Brooklyn Motor Vehicle Dealers' Assn., 23d Regiment Armory. I. C. Kirkham, Mgr. Passenger cars Feb. 23-Mar. 2; Trucks Mar. 5-9.

Feb. 25 - Mar. 2—Indianapolis, Indianapolis Automobile Trade Assn., Diamond Chain Work Bldg. John B. Orman, Mgr.

Feb. 25-Mar. 2—Muskegon, Mich. Second Annual, Merrill Auditorium. John C. Fowler, Mgr.

Feb. 25 - Mar. 2 — Bridgeport, Conn., Fourth Regiment Conn. Home Guard, State Armory and Casino. B. B. Steiber, Mgr.

Feb. 27-Mar. 2 — Columbus, O., Auto Exhibitors Co. W. L. Carney, Mgr.

Feb. 27-Mar. 6 — Boston, Mass., Salon, Boston Automobile Dealers' Assn., Copley Plaza Hotel. Chester I Campbell, Mgr.

Mar. 1-15—Lyons, France, Third Sample Fair.

Mar. 2-9—Boston, Mass., Boston Auto. Dealers' Assn., Mechanics' Bldg. Chester I. Campbell, Mgr.

Mar. 2-9—Pittsburgh, Pa., Automobile Dealers' Assn. of Pittsburgh, Motor Square Garden. John J. Bell, Mgr.

Mar. 4-9—Utica, N. Y., Utica Motor Dealers' Association, Inc., State Armory.

Mar. 6-9—Clinton, Ia., Clinton Automobile Dealers' Assn., Coliseum.

Mar. 6-9—Watertown, N. Y., Automobile Dealers, Inc., State Armory. Arthur E. Sherwood, Mgr.

Mar. 6-9—St. Joseph, Mo., St. Joseph Automobile Dealers' Assn., Auditorium. John Albus, Mgr.

Mar. 8-11 — Green Bay, Wis., Brown County Automobile Trade Assn.

Mar. 11-16—Cedar Rapids, Cedar Rapids Auto. Trade Assn., Auditorium.

Mar. 15-20—Great Falls, Mont., Montana Automobile Distributors' Association, Lexington Garage. A. J. Breitenstein, Mgr.

Mar. 16-20—Great Falls, Mont., Montana Automobile Distributers' Assn.

Mar. 19-24—San Francisco, Cal., Motor Truck Dealers of San Francisco, Auditorium. Ivan R. Gates, Mgr.

Mar. 19-24—Cedar Rapids, Ia., Cedar Rapids Auto Trade Assn., Auditorium.

Mar. 20-22—Houlton, Me., Second Annual, Houlton, Motor Car Dealers' Assn., Bangor St. Exhibition Hall. J. D. Luth, Mgr.

Mar. 20-23 — Trenton, N. J., Trenton Auto Trade Assn. Second Regiment Armory. John L. Brock.

Apr. 9-13—Stockton, Cal., San Joaquin Auto Trade Assn. Samuel S. Cohn, Mgr.

Sept. 23-28 — Chicago, National Accessory Show for Fords. Coliseum.

S. A. E.

Feb. 1 — Chicago, War Dinner during Winter Meeting.

ENGINEERING

American Society of Heating and Ventilating Engineers.
Mining and Metallurgical Society of America.